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The Strike Situation.

While there is no decided or striking change in the general strike situation since we wrote of it last week, it may be said that the strike is manifestly nearer its end and that the general movement has been decidedly against the men, they having given up in numerous cases and gone back to work upon terms practically dictated by the employers. There has been a decided weakening at Cincinnati, where the most determined fighting was done and at Newport News, Bridgeport, Conn.; Richmond, Va.; Scranton, Pa.; Seneca Falls, N. Y.; here in New York city and elsewhere men have returned to work in such numbers as to make it morally certain that not much of the strike will be left by the end of the present week.

One notable feature of the situation is the trouble that has broken out between the National Metal Trades Association and the National Civic Federation. One of the objects of the Federation, as we have previously mentioned, is the avoidance or healing of industrial troubles, and in accordance with this the officers of the Federation issued a statement regarding the strike in which is a passage as follows:

"The questions underlying the machinists' strike are of a far greater importance to the industrial future of this country than the mere strike itself. If, as many of the large and far-seeing manufacturers and all students of the question concede, the shorter-hour day is coming, is there any way, through agreement, to usher it in by easy stages, or must it come through the revolutionary method of strikes with all the attending distress and too frequent bloodshed? Some of the best minds in the manufacturing world to-day believe that a plan can be worked out.

"The Industrial Committee of the National Civic Federation is taking up the matter, and will hold a conference on the subject in the fall at Pittsburgh or Cleveland, when not only the shorter-hour day will be discussed from every standpoint, but also the other questions involved in the machinists' controversy, which we met with more or less in nearly all lines of industry, such as the piece system, the limitation of work, and apprenticeship restrictions."

The secretary of the National Metal Trades Association is reported to have been deeply offended at this and to have expressed the opinion that it shows that the Federation is not an impartial body and that what they say about the "eight-hour work-day"—*sic*, is "dangerous in the present condition of the labor market." Of course when men are engaged in a fight no opinion or comment whatever appears to them to be at all fair or reasonable, unless it is squarely and entirely on their side. Those who know anything of human nature will not expect anything else. To an impartial observer it will not appear that the Federation has committed any very heinous offence. It has simply recognized the indisputable general trend toward a shorter working day and in effect expressed the hope that it will come about by peaceable instead of fighting methods. And inasmuch as the National Metal Trades Association has so far recognized the shorter-day idea as to enter into an agreement to put it in force—an agreement which would be valid and binding to-day had it not been abrogated by the action of the officers of the International Association of Machinists—it is a little difficult to see why any officer of the National Metal Trades Association should now take such serious exception to its recognition by others. The fact that the machinists' organization struck in violation of an agreement after refusing a chance to arbitrate under the terms of the agreement does not alter the nature of the agreement itself or necessarily make it a bad one, though of course it will have a decidedly discouraging effect so far as the entering into any new agreements with the same men is concerned.

Two propositions to arbitrate made by the machinists' organization through the Federation have been declined by the National Metal Trades Association—one for a general settlement by a return to work on the nine-hour day basis with local settlement of wages rate by arbitration, the other for a settlement in the New York district on practically the same terms. These terms are the same as were contended for at the beginning of the strike by the National Metal Trades Association and their refusal to now accept them when offered by the men simply means that by the strike and the subseqent course of events the situation has changed and that the members of the National Metal Trades Association now think that this is as good a time as any to discourage the idea that anyone but the proprietor of a shop can be trusted with its management and that the way to make the machinist's business prosperous is to restrict it and prevent the full use of improved labor-saving machinery.

Measuring to the Millionth Part of an Inch.

It is frequently the experience of a machinist that when he refers to the now common practice of the shops of working to a limit of a thousandth or of half that amount, he is regarded as a person prone to "impart to the truth an undue degree of elasticity" or as one who is not in the habit of knowing just what he is talking about. If it seems to the skilled machinist rather foolish for people to deny the possibility of doing a thing just because they themselves do not know how to do it, what shall be said of those machinists who deny the possibility of measuring much finer than any micrometer or gaging machine can measure, simply because they themselves do not understand the methods by which this is accomplished. The machinist who denies with scorn and indignation that anyone can measure to the millionth of an inch should think of those misguided people who deny with equal scorn and indignation that anyone can work finer than a 64th of an inch, or at best to half of that.

All machinists worthy of the name are more or less interested in matters related to the machinist's art, though they may not be a part of it. The machinist is interested in the production of surfaces and of straight edges of the utmost possible accuracy and in the measurement of the

smallest possible distances or magnitudes. Every one of our readers, therefore, ought to be greatly interested in the articles by Prof. Gale, the second of which appears elsewhere in this issue. Prof. Gale shows how magnitudes or movements amounting to no more than one-half a millionth of an inch are easily and surely measured and has made a special effort to explain the apparatus, its principle and method of operation in such clear and non-technical language as to make them easily understood. By the method which he describes straight edges and surfaces of glass and metal are produced which are so much closer to absolute accuracy than the best and finest work produced by the machinist that the two compare about as a roughly chipped surface and a finely finished surface-plate do.

There are those who are so constituted as to take very little interest in processes aside from the results obtained by such processes. Such people will say, "What is the use of such extreme refinement?" To this we can only say that the process and apparatus are very interesting independently of the results obtained by them and that the ability to make such fine measurements is of very great use in the apparatus employed in physical research. A practical application of Prof. Michelson's Interferometer that will be readily appreciated by machinists accustomed to fine measurements is in the fact that by it, as we believe, there exists the first known absolute standard of measurement or of length. All previous attempts by pendulums or otherwise to establish an absolute standard of magnitude that could be reproduced with absolute certainty within the smallest appreciable limit of error have failed. It is a rather impressive fact that if all the standards of length in existence should by any means be lost or destroyed skilled mechanicians with this and last week's "American Machinist" in their possession could reproduce these standards within such a small limit of error (about $\frac{1}{1,000,000}$ inch) that it would be entirely negligible for all practical purposes.

The Allis Engines at Glasgow.

Some of our British exchanges have been having a good deal to say about the performance of the Allis engines which have been recently installed in Glasgow for street railway service. There has been considerable agitation about this contract ever since it was awarded to the American builders in competition with the home builders, and the agitation has been renewed upon the failure of the engines to operate satisfactorily upon the date set for them to do so; and it has been stated that the subsidiary engines of British manufacture had to be depended upon to do the work intended to be done by the larger engines of American build, but which the latter would not do, because the bearings heated, "were of insufficient length" and because the engines were, in short, "very poorly designed" and "very poorly built." We have accordingly been at some pains to ascertain the truth about this matter, and find the following to be the facts:

The construction of the Glasgow powerhouse was so much delayed that the American engines, after being delivered in Glasgow, lay outside of the building over two months before a start could be made upon the erection. This meant that the erection was rushed to the utmost, as the Glasgow people were exceedingly anxious to have the engines ready for service at the opening of their Exposition, which made it necessary to put the engines into regular work at once without any opportunity to break them in, and, as a result, certain stoppages were necessary to adjust oil pipes, etc. The authorities who purchased the engines are well pleased with them, and it would seem, therefore, that most others should be.

Since the above was put in type we notice in "Engineering" an official report which we reprint below. And we may say that though we have seen very much in our British contemporaries about the alleged bad working of the Allis engines, this report gives us our first information that there were British engines that had not done in all respects what was expected of them:

"Glasgow Tramway Committee.—At the usual fortnightly meeting of the Tramways Committee, held on June 26, the General Manager reported that satisfactory progress was being made all around at Pinkston Power Station, and that the machinery in operation was working well. In addition, a report was submitted by Mr. Parshall, the consulting engineer, which gives the position of the works as at this date. Mr. Parshall says: 'I have pleasure in reporting favorable progress since seeing you three weeks ago. The electrical machinery in the sub-stations and all of the underground cables have given entirely satisfactory results. There have been no electrical difficulties whatsoever. In the power station the boiler-house arrangements are approaching completion. The coal-handling machinery has been tested and found satisfactory. The first economizer has now been put in satisfactory working order, and the second one is well forward. The outside coal-handling machine has been tested and found satisfactory. Generally, everything in operation in connection with the boiler-house is working well. As regards the engine room, the two Stewart engines, which have been working for some weeks at about half-load, were taken out of work on June 14 and one handed over to the Stewart Company for general overhauling, the second engine being held as a standby for the working of the auxiliary power plant in case of failure of supply from Dalhousie. This second machine will be turned over to the Stewart Company as soon as the first machine is put in working order. What I am asking the Stewart Company to do is to make such arrangements as will enable me to use the engines under usual working conditions. As yet we have been unable to work these engines with the governor, and have had to work them always with a man at the throttle. The little trouble at first experienced from warm pins with the Allis engines has entirely disappeared. No. 1 Allis engine has been carrying the car load for eleven days and the No. 2 for sixteen days. The average load on an engine for 250 cars amounts to some 1,400 kilowatts. The average output from the station amounts to .93 Board of Trade units per car mile, which figure will indicate to you that the system generally is working efficiently and well. As regards the Musgrave engines, the first commenced turning ground on Monday last. There have been some incipient troubles from heating, but not more than might reasonably be expected in starting a new engine. The engine will be put on artificial load on Saturday first, provided things go on satisfactorily, and it is expected it will be in satisfactory working order for car load in a week from that time. We are pressing the contractors for the cranes to complete their contract. As you know, these contractors have been a cause of serious delay in connection with the execution of the engine contracts. They are now, however, actually at work overhauling one 50-ton crane, and report the 30-ton crane ready for trial. The condenser and auxiliary plant generally are working satisfactorily, and have given no unusual trouble from the beginning.'"

Die Forming by Hydraulic Pressure.

A contemporary published recently an elaborate account of a method of forming hollow sheet-metal articles by placing them in a die made up in sections and bound together, after which the hollow blank is filled with a fluid, on which pressure is exerted by a plunger to expand and drive the metal into the impressions in the die. This process was mentioned to a number of Americans at Paris last year as being the invention of a resident of Germany. The fact is, however, that this process—so far, at least, as its general features are concerned—has been in use in this country for a long time. Many of the articles made by the Gorham Manufacturing Company, of Providence, are formed in this way. Mr. F. C. Lawton, the superintendent of their works, informs us that considerable experimenting has been done on this work and that a number of costly machines have been invented and built for it, but that the one they are now using is entirely satisfactory.

Friday, September 13, 1901, has been designated as Railroad day at the Pan-American Exposition.

The Lessons of the Automobile Race

The great automobile race from Paris to Berlin has not taught us many things, but one or two of them are worth noting and remembering.

The first is, that the manufacturers of such conveyances have not succeeded in their attempt at producing machines which will stand everyday wear at high speed, such as is achieved by the locomotive, the marine engine and other mechanical combinations which are at work all around us, and which stand use and abuse with little complaint or breakage. With every new type of locomotive engine for railway purposes there is usually found some one element of trouble common to all; it may be that the cross-head runs hot, or the staybolts break, or what not. This defect shows itself on all machines of the same type, and may be done away with by changes in design or construction, leaving the new machine serviceable. But in the automobiles of the same type—sister machines, so to say—there seems to be no one part more tender than another, because all seem to let go with impartial frequency—frame, gearing, engine proper, generators, subsidiary parts, tires. "Spares" must be carried to an absurd extent. Despite the speed which has been shown by some of these machines, the gross horse-power compared with the work, as represented by the product of weight and distance, is high; and compared with the weight and revolutions the net horse-power is low. That is, the friction, both of the conveyance and of the engine and gearing, is high, and this largely owing to the fact that the whole structure is stiff where it should be limber, and *vice versa*.

The fact that, taking the productions of any one maker, there are so many rapidly succeeding and widely differing "models," proves (1) that the builders are not sure of themselves and (2) that the conditions of ordering, the relation between amateur driver and half-amateur constructor, are such that prolonged experience with any one type is almost impossible. Every purchaser wants something entirely different from the preceding ones; each time an entirely new design has to be made. Shipbuilding—even warship building, where the hull and armament plans are turned over to the engine designer with the cool demand to utilize the remaining space for his boilers and engines—is nothing to the conditions here.

The second lesson is that automobile racing, as a sport, is no sport. To sit for eight hours in a cramped position, in leather clothing, with mask and goggles, and endure the physical discomfort arising from wind and dust and jolting, and the mental strain arising from the necessary watchfulness, is no fun; and adding to this that the racing medium, considered in itself, is utterly unsympathetic and devoid of ambition and eagerness in the competition—where is your port? This is especially the case where general conditions of such a race preclude any "brushes" between competitors. It is like a boat-race where there is not room enough for two crews "side and side," and each rows solemnly over the course, and back, in his turn.

The third lesson is, that even were automobile racing sportsmanlike when the conditions were favorable, these conditions cannot again be made favorable. For weeks beforehand the course between Paris and Berlin was placarded with notices of the coming race, and rules laid down to ensure the safety of the competitors and of the general public. Committeemen with blue and with yellow flags were on hand at short distances apart; mounted police were strung along the road the entire distance—and for all that a man and a child, among the spectators, were killed. Outside of that, the general public, however much excited and interested, was decidedly impeded in its everyday work.

The accidents to machines and drivers were so numerous as to be impossible to record. I will only say that in attempting to pass a machine ahead, one of the two German automobiles, owing to the dust cloud, and perhaps to defective steering, was run into a tree and ditched, and one of its occupants had a broken arm, leg, skull and ribs, and will probably lose one eye.

Taking it "by and large," this race has probably done more harm than good to the entire automobile industry. It has demonstrated (at the cost of two human lives and many thousands of dollars) that the machines are dangerous and unreliable at high speeds, even when run by the most experienced "chauffeurs" ("chauffés" would be more appropriate!) and the entire poetry of the thing—what little there was—has been taken out of it. The real value of the automobile has been shown to be in its adaptability to slow and reasonably rapid conveyance on ordinary roads under ordinary conditions of traffic, and builders will do well to "get in out of the wet," and stop building machines for races which are torture to those taking part and dangerous both to competitors and spectators—and which, furthermore, in all probability, no government will allow to be repeated.

ROBERT GRIMSHAW.

Hanover.

The recent tragic death, at his summer home near Milwaukee, of Wm. E. Fitzgerald, of the American Shipbuilding Company, calls attention to the danger of escaping illuminating gas. In this case there was a gas generating apparatus in the basement of a residence on the shore of Lake Nagawicka. Noting a defect in the lights, Mr. Fitzgerald began an investigation and detected the odor of escaping gas. With the coachman and a lighted candle he went to the basement. The danger of the light was not ignored, but it was thought that there was not enough gas to ignite. An explosion, however, occurred and Mr. Fitzgerald died a few hours later.

Commercial Review.

NEW YORK, Monday, July 15.

MACHINE TOOL MARKET AND GENERAL NOTES.

The latest news indicates that as an important factor at least, the machinists' strike will not be long to take account of in the future. Such a resumption of operations in the affected works as appears now to be going on, if it continues, ought not to take long to eliminate the effects of the labor trouble from the general market, even if the strike is not formally declared off at all points, for a good while to come. Looking back over it, the effect upon trade has been so much less than might have been expected that an early obliteration of its traces may be looked for.

Business itself is accustomed to go on strike at this season of the year, but at present is doing so only to a restricted extent. Some of the prominent factors in the market notice practically no falling in their trade. One house has in the last few days closed three orders which together aggregate about $20,000. While there may not be many large operations going through now there is prospect for some in the fall, and at present one railroad shop equipment is incipient, which will include a large quantity of wood-working and presumably metal-working tools.

In view of the slump that occurred in the foreign machine-tool trade last year and the continued stagnation, especially in Germany, which is even asserted to be more depressed than it has been in the last fifteen or twenty years, it is easy to become discouraged and treat European business as unworthy of further attention. That such an attitude is unjustified is indicated by the statistics for export shipments of metal-working machinery during the month of May this year, which show $344,354 in amount. This is against $591,532 for May, 1900, and is about half the monthly average when trade was at a maximum.

Especial significance therefore attaches to the foreign tour of Frederick Eberhardt, of Newark, N. J., who started recently on a trip to Great Britain, Germany, Austria, France and Switzerland. Mr. Eberhardt intends to look into the troubles affecting foreign trade and see if the difficulties cannot be in a measure at least overcome. His company, Gould & Eberhardt, is still doing a fair business abroad, however. They have recently made a gear cutter shipment to Switzerland, for instance; they have now on hand orders from England calling for gear cutters, and they are finding quite a good demand in Scotland for their shapers. The general

business of the company is active and seems to have been improving somewhat after a relatively quiet period about the close of last year.

The establishment on British soil of electrical manufacturing companies under American control or in other respects strongly American in character is to be rendered still more interesting by the construction of a British Bullock factory. The Bullock Electric Manufacturing Company, of Cincinnati, has been having notable success with its English trade and has for some time been considering the foundation of a plant where it can build machines on the spot. Messrs. Bergtheil and Young, the English representatives of the company, have been in America this summer and George Bullock has just sailed for England to select a site and arrange other details for the new plant. Some British capital is to be involved in it. This undertaking on the part of the Bullock people certainly has the appearance of a bold one in view of the generally depressed condition of foreign affairs and the competition in electrical manufacture, which is already sharp and seems destined soon to be sharper. They seem, however, to have reason for confidence in a continued demand for their products, and further it might be argued that they will be better prepared for the struggle for foreign trade, however fierce, by having a branch or affiliated works on European soil like their chief competitors, than by depending upon building all their machines in Cincinnati. As a matter of fact, the home works are now taxed to utmost capacity, being operated day and night, and a new building 125x60 feet is about to be built for a pattern storage house, besides a 30x100 foot extension of the brass foundry and pattern shop. The equipment of the British Bullock plant, while a matter for the future to arrange, will undoubtedly be American, and while it will probably not be so extensive as that of the British Westinghouse plant, it ought to be a very nice plum for the tool builders. From the identification of the Bullock company with Cincinnati, the tool manufacturers of that city may hope to obtain some very good-sized bites of the plum when it ripens and falls.

The British Westinghouse Electric & Manufacturing Company, has placed a contract for cranes in England, as we stated in No. 19 would probably be the case. Craven Brothers, of Manchester, have received from them an order which calls for eight electrical traveling cranes, one of them having a safety working load of 50 tons and a span of 90 feet.

The partnership Binsse & Hauschild, manufacturers of horizontal boring mills at Newark, N. J., which has been doing business as the Newark Machine Tool Works, announces its incorporation as the Binsse Machine Company. This is for the purpose of preserving the business in the case of the death of either of its owners.

One of our friends who has the local management of a line of instruments such as machinists buy for themselves says that workmen have of late been selling their tools to the second-hand dealers. This is a commercial fruit of the strike which is to be regretted, even if it results in the disposal of a few more new tools later on.

Machinery, Machines, and Parts of—	May—				Eleven Months Ending May—					
	1900		1901		1899		1900		1901	
	Number.	Dollars.	Number.	Dollars.	Number.	Dollars.	Number.	Dollars.	Number.	Dollars.
Cash Registers	....	70 988	800	61,377	....	.....	....	755,212	1969	871,321
Electrical	....	538,678	...	492,494	....	2,517,797	....	3,834,317	....	5,356,124
Laundry Machinery	....	59,824	....	58,163	....	.....	....	402,831	....	434,406
Metal-working	....	591,532	....	344 354	....	5,882,165	....	6,593,263	....	3,871,440
Printing Presses, and parts of	....	99,244	....	44 314	....	772,181	....	1,100,787	....	949,922
Pumps and Pumping Machin ry.	....	222,387	....	216,593	....	2,484,783	....	2,836,621	....	2,020,106
Sewing Machines, and parts of	....	393.283	....	393,580	....	2,949,164	....	4,115,953	....	3.837.769
Shoe Machinery	....	72,957	....	115,079	....	777,277	....	1,080,391	....	879,840
Steam Engines, and parts of—										
Fire	1	5,180	2	3,300	2	10,173	2	13,315	13	21,770
Locomotive	45	421,731	52	449,823	443	4,009,347	496	5,277,106	395	3,732,576
Stationary	95	61,974	113	77,026	519	286,709	1011	579,138	1206	857,543
Boilers and parts of Engines	....	190,509	....	148,961	....	1,049,482	....	1,026,530	....	1,552,439
Typewriting Machines, & parts of	....	223,827	....	258,967	....	2,213,540	....	2 481,699	....	2,594,413
All other Machinery, and parts of	....	2,069,649	....	1,797,420	....	17,056,510	....	19,766,940	....	19,355,089

UNITED STATES OFFICIAL STATISTICS OF EXPORTS OF MACHINERY OF DOMESTIC MANUFACTURE, INCLUDING MAY, 1901.

CHICAGO MACHINERY MARKET.

The trade in machinists' supplies for July is better than for any July in many years. The activity is so marked as to surprise those who are benefitted thereby. Usually the first five months of the year are the most active. This year May with several important houses was the best month ever experienced. June showed some decline from May, but was a notable one. July for its first half shows little if any diminution from the trade of June. Generally very little is expected of the month. There are supply houses which are working overtime, evenings and Sundays, to keep pace with their mail orders. C. H. Besly & Co. say they are shipping Gardner grinders by the carload, running their plant twenty-two hours a day, and are way behind in their orders. For all kinds of machinists' supplies trade is very good. The Machinists' Supply Company reports the best summer business it has ever experienced. Samuel Harris & Co. say they would be swamped were it not that the plants of some of their customers were closed by strikes or other causes.

This beneficent condition of things is felt at its best by those sellers who carry a general line of supplies. Coming down to specialties, there is a variance of reports. Some representatives of manufacturers say they are extremely busy; others that they have only a moderate July trade. Summing it all up, this summer's trade is running considerably ahead of that of 1900, but there is is a moderate decrease in activity, as compared with the spring months. At quite a number of Western shops there is idleness to take inventory and make repairs. While this reduces consumption it leads on the other hand to the placing of some considerable orders for supplies which are found to be well exhausted.

The season of the implement makers is ending and with many of them there is a spurt in shop activities to get out some rush orders. The actual shutdowns as yet are less important and are fewer than usual in July. From what straws may be seen, by way of orders for material for the coming season, there is no indication that manufacturers do not anticipate a continuation of production on as great a scale as for the year now closing. The activity in the supply market certainly denotes only a brief suspension of operations this summer.

Quotations.

New York, Monday, July 15.

Pennsylvania Foundry Pig Irons, Jersey City delivery, good brands:

No. 1 X.....$15 15 @ 15 50
No. 2 X..... 14 65 @ 15 15
No. 2 plain..... 14 15 @ 14 65
Gray forge..... 13 75 @ 14 50

Alabama Pig, New York delivery:

No. 1 foundry, or soft.... 15 00 @ 15 50
No. 2 foundry, or soft.... 14 25 @ 14 75
No. 3 foundry..... 13 75 @ 14 00
Foundry forge, or No. 4.. 13 25 @ 13 50

Bar Iron—Base sizes—Refined brands, mill prices on dock, 1.58c.; from store 1.80 @ 1.85 @ 1.90c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades,, 10c. and upward.

Machinery Steel—Base sizes—From store, 1.90 @ 2.00c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½ @ 2¾c.

Copper in carload lots—Lake Superior ingot, 17c.; electrolytic, 16⅝c.; casting, 16¼ @ 16⅝c.

Pig Tin—28 @ 28½ c. for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—3.90 @ 3.95c., New York.

Antimony—Cookson's, 10¼ @ 10⅜c.; Hallett's, 8¾c., while some brands may be quoted at 8½ @ 8¾c.

The Interferometer—II.

BY H. G. GALE.

The instrument is usually mounted on a brass or cast-iron bed, made as indicated in Fig. 4. After being planed carefully in the shaper, the edges *a b* and *b c*, shown in the "section through *A B*," are scraped as nearly straight as possible. The surface *d e*, inclined at an angle of 45 degrees and parallel to the intersection of *a b* and *b c*, is also scraped carefully, although it does not need to be as perfect as the other two edges. A carriage which bears at each end against *a b* and *b c*, and in the middle against *d e*, slides back and forth on these straight ways and carries the movable mirror *C* of Fig. 2, which is held in a brass frame, screwed firmly to the carriage. A screw, usually of ½ millimeter, or 1-50 inch, pitch, runs the whole length of the bed and turns in block bearings at each end. This screw is ground with considerable care, to be as uniform and as nearly cylindrical as possible. Motion is communicated to the carriage by a nut which fits over the screw and is kept from turning by a steel knob which fits into a groove at the bottom of the bed. This groove is shown at *f* in the "section through *A B*." A steel ball on the top of the nut fits into a steel pocket in the bottom of the carriage and carries the movable mirror forward and back as the screw is turned.

One end of the bed is planed off flat across the top and a brass strip is screwed on at right angles to the ways. This strip holds the two plane parallel plates *A* and *B* of Fig. 3 and the fixed mirror *D* of Fig. 3. The movable mirror *C* and the plane parallel plates *A* and *B* are held in brass frames by springs which press them against the heads of screws set in the upright arms of the frames. The heads of the screws project in beyond the edges of the frames far enough to catch the edges of the glass plates. The instrument is brought as nearly as possible into adjustment by turning these screws and the final fine adjustment is made on the fixed mirror D by turning the fine screws *S* and *S'* which press against the fairly delicate springs *t* and *t'*, indicated in the plan and end elevation, Fig. 4. The frame which holds the fixed mirror is held to the piece through which these adjusting screws pass by a single slender steel rod *E*. This rod is bent by the pressure of the adjusting screws *s* and *s'* against their springs, thus furnishing a very delicate means of changing the angle of the fixed plate slightly, in order to change the direction and width of the fringes.

The screw which moves the carriage forward and back is provided at one end with a graduated circle *F*, divided usually into 100 parts. The edge of this circle is cut to fit a worm *W*, which may be thrown into or out of adjustment, thus providing for a slow or fast motion of the carriage. The end of the worm shaft also bears a divided circle *G*, usually calibrated to

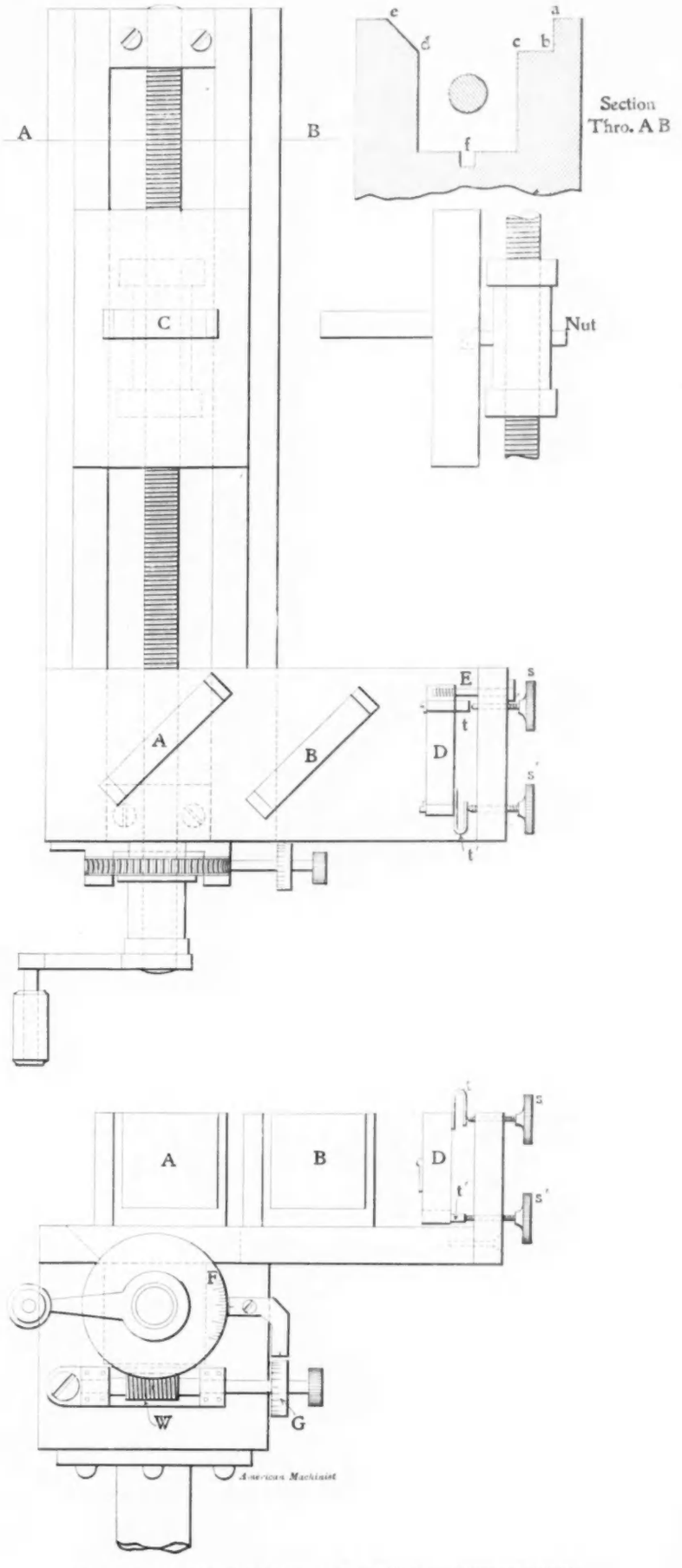


FIG. 4. PLAN, END ELEVATION AND DETAILS OF INTERFEROMETER.

twenty-fifths of a turn. If the pitch of the screw is 1-50 inch and the screw head has 100 teeth, one tooth will advance the movable mirror .0002 inch. If there are twenty-five divisions on the head of the worm shaft, a motion of one of these divisions will advance the mirror .000008 inch. Since the mirror must be moved up one-half wave length, or about .000012 inch, to cause a shifting of one fringe, the worm head must be turned about 1.5 divisions to cause a shifting of a single fringe. Therefore as the worm head is turned and the fringes move they may be easily counted. Fig. 5 is from a photograph of a complete instrument, mounted and ready for use.

If it is desired to test a screw, the screw is mounted in the bed of an interferometer and made to move the carriage. It is best to adjust the mirrors so that the fringes will appear as circles. This will be the case when the fixed and movable mirrors are unequally distant from the plate which divides the light, and when

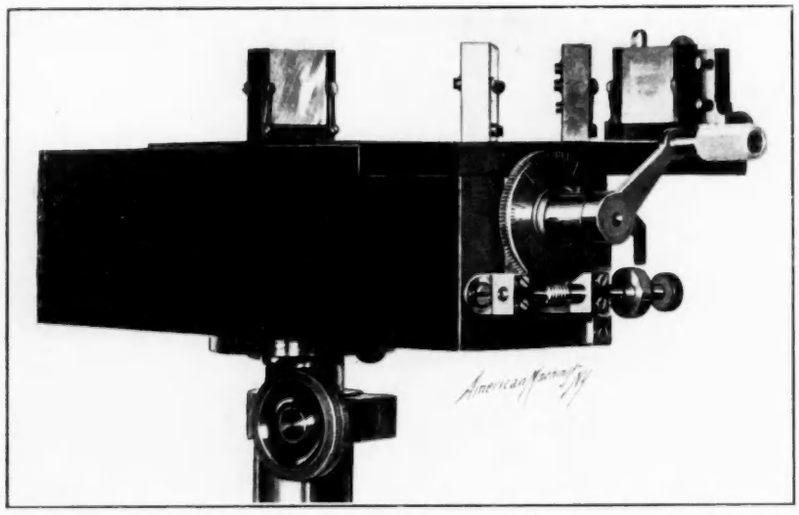


FIG. 5. COMPLETE INTERFEROMETER ARRANGED FOR TESTING ACCURACY OF SCREWS.

the reflection of the fixed mirror, in the plate which divides the light, is exactly parallel to the movable mirror. Starting at any chosen point, the number of fringes passing for one turn of the screw could be counted. If the screw were perfectly uniform this number would be exactly the same for each succeeding turn of the screw, and any variation in the number of fringes passing would be a true measure of any irregularities. Since moving the screw back 1-50 inch would cause about 2,000 fringes to pass, and a difference of one-twentieth of a fringe could be detected, this method would measure an error in the screw amounting to no more than $\frac{1}{2,000,000}$ inch.

However, it would involve an enormous amount of labor, and almost certain errors, to count as many fringes as mentioned above. The practical testing of a screw is therefore carried on in a slightly modified way. The screw is first tested by mechanical means, and it must, of course, be very accurate to begin with, or it would not be worth while to attempt to compensate for its imperfections, or to test it by such delicate methods. A screw is therefore selected which is accurate to within a fractional part of a wave length for a half or a quarter of a turn. No attempt is made to count the whole number of fringes which pass when the screw is turned a certain amount, but the fractional part of a fringe is determined with great care in the following way: The frame which holds the "compensating glass" of the interferometer is held at one end by a stiff steel spring. To the other end is fastened a spiral spring, with a string running over an axle, which is provided with a calibrated head. As the axle is turned the spiral spring is stretched and the compensating glass is turned through a small angle. This change of angle will cause a shifting of the fringes as explained above, because it changes the length of the path of the light through the glass. By trial it is found how many divisions on the head correspond to a shifting of one fringe in the interference bands. The compensator is then adjusted so that one of the black fringes with monochromatic light is just disappearing at the center of the field, this position of a fringe being the easiest to determine accurately. The screw which is being tested is now given, for example, a quarter of a turn. If sodium light is being used there will pass, say, 424.26 fringes. The whole number is ignored but the fraction is determined as carefully as possible by the compensator, the number of divisions in the compensator head necessary to bring the next fringe to disappearing being interpreted in fractions of a wave length. The fringes being again adjusted so that one is just disappearing at the center, the screw is given another quarter of a turn, and the fraction is determined again. If the screw is at all good there ought not to be a variation of one part in a thousand anywhere in its length. There will then be no variation in the whole number of waves which pass for any quarter of a turn, and the variations in the fractional parts will be an accurate test of the uniformity of the screw. If the screw is found to be sufficiently accurate the fraction need be read only every half revolution, but if it is less accurate than was expected it may be necessary to take the readings at each eighth or sixteenth turn. In general, a small enough fraction of a turn must be used so that the maximum variation in the fractional part of a fringe will not be more than .30 or .35, because if the variation should amount to .5 or more it would be impossible to tell whether this fraction corresponded to an increase or decrease in the distance moved. To illustrate, take the number given above, 424.26 fringes for a quarter turn of the screw. If the succeeding fractions are .37, .54, .13, .98, we may be fairly sure, if there are nowhere variations greater than these, that the numbers were 424.37, 424.54, 424.13, 423.98. But if one of the fractions should be .75, it would be impossible to tell whether the number was 424.75 or 423.75, each being about the same distance from the original number, 424.26.

In this way every part of a screw may be tested, and the errors may then be corrected automatically, or at any rate their amount will be known and the value of the screw for different uses will be determined. A certain limited portion of a screw will usually be found to be more accurate than the rest, and this part may be sufficiently accurate for the use intended.

It will be found that many little things must be taken into account in making a test of this sort, to get the best results. For example, the carriage must be of proper weight; if too heavy it may strain the instrument so as to cause errors in the readings of the fringes, and if too light it will be too easily disturbed by dust on the sliding ways. The nut which fits over the screw and moves the carriage must not fit too loosely nor too tight, and it must have a thread which will fit the thread of the screw. The ball on the nut and the pocket in the carriage must fit each other smoothly; the knob on the bottom of the nut must slide smoothly in its groove below the screw. Irregular temperature effects must be avoided; the amount of lubricant on the screw and on the straight ways must be regulated with care, and many other little things will be found to affect the final outcome.

A straight edge which has been scraped with the greatest care by the ordinary method of comparing three with one another, may be shown by interference methods to be still far from perfect. The form of instrument best suited for this purpose is that used for the measurement of small angles, and outlined in Fig. 6. Light from a source *S*, rendered parallel

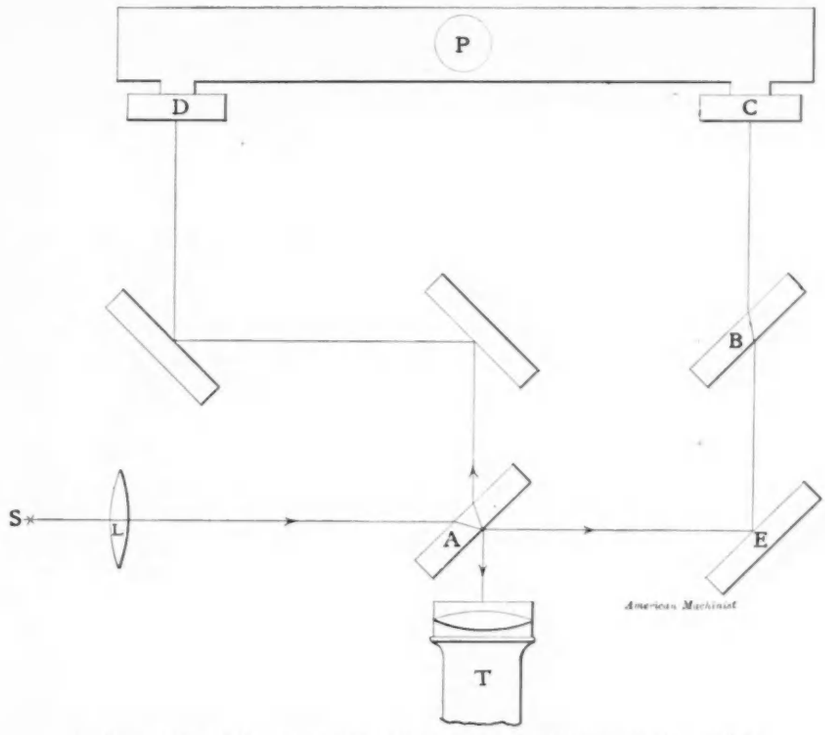


FIG. 6. ARRANGEMENT OF INTERFEROMETER FOR MEASURING SMALL ANGLES.

by the lens L, falls on the plane parallel plate A, which has the thin coat of silver on its farther surface. The light is divided, part of it going to C and part to D over the paths indicated. It returns over the same paths and enters the telescope or eye at T, where the fringes may be observed. B is the compensating glass. The conditions for interference are the same as they would be between the reflections of C and D as seen in A. The theory of the instrument is exactly the same as that of the form described above, but it is especially adapted to the measurement of small angles. Fig. 7 is from a photograph of an instrument of this kind which formed part of the Ryerson laboratory exhibit at the Paris Exposition. The mirrors C and D are mounted on a common arm, which is clamped to a support P, a steel rod about 2 inches in diameter. All the plates and mirrors except C and D are mounted on an iron base. The mirror E is made to slide in ways on this base, parallel to itself, its motion being regulated by the calibrated head F. By means of it the path of one beam of the light may be made longer or shorter, until the two paths are equal and the fringes appear with white light.

If the rod P is twisted to the right, for example, the mirror C is brought nearer to A and the mirror D is moved farther away. If C is brought up a quarter of a wave length and D is moved back a quarter of a wave length, the effect on the fringes is the same as though one of the mirrors had been moved one-half wave length. There will therefore be a shifting of one fringe in the interference bands. In the instrument of Fig. 7 the distance between C and D is about 10 inches. Therefore when C is moved up one-quarter wave length, about .000005 inch, the arm carrying C and D is turned through about .000001 radian or about .2 sec. Since a motion of one-twentieth of a fringe can be read, an angle of .01 sec. may thus be measured. This is about the angle which the head of a pin would subtend 10 miles away.

Considering the arrangement in Fig. 6 it will be seen that the fringes ought not to shift if the arm bearing C and D is moved back exactly parallel to itself, because the paths of the two rays from A to C and D would still remain exactly equal to each other. But if the arm bearing these two mirrors is turned through a very small angle, as shown above, the fringes will be displaced. A straight edge may then be tested in the following way: The straight edge M, Fig. 8, is made one of the straight ways of an interferometer and the mirrors C and D are mounted on the carriage N, which slides back and forth on these straight ways. The carriage is set at one of the ways and the fringes with white light are brought into the field by adjusting the movable mirror E. Since the best fringes with white light are straight instead of circular, the central black fringe of the system is used as a point of reference and set on the cross-hairs of the observing telescope. The carriage is then moved back a certain distance and if the straight edge is not perfectly straight the fringes will be displaced a certain amount, because the carriage and its mirrors are turned through a slight angle. If the end of the carriage is set at a number of equidistant places

FIG. 7. INTERFEROMETER ARRANGED AS IN FIG. 6.

along the straight edge and the number of fringes displacement is read at each place, an accurate idea of the shape of the straight edge may be obtained. The displacements in one direction will correspond to high places on the surface, and deflections in the other will correspond to hollows. By twisting the arm which carries the mirrors slightly and observing the way in which the fringes move, it may be known at once which direction of displacement corresponds to high places and which to low places in the straight edge. After the high places have been located in this way, the carriage is removed and the surface is scraped carefully at these points. The carriage is then put back and another set of readings is taken with the fringes, and the parts which the interferometer shows to be still out are scraped again. It has been found necessary to wait some little time after scraping a straight edge before testing it, as the scraping seems to heat it in such a way as to raise minute protuberances which subside as soon as the metal becomes completely cool. It will be found necessary, especially with heavy castings, to give the material plenty of time to set after it has been planed or bored, as the gradual warping is very slow.

Straight edges which have been scraped with the greatest care by the usual method of preparing three together and which appear to be perfect when compared with each other, show under this test deflections of from thirty to eighty fringes. These deflections correspond to errors of from $\frac{6}{100,000}$ to $\frac{16}{100,000}$ inch. It would seem, then, that the limit of accuracy by the ordinary method is about $\frac{1}{10,000}$ inch. By careful scraping such errors may be removed, so that there is no motion of the fringes as the carriage is moved back and forth, and the straight edge is therefore perfect to within .01 second of arc. If, as in the case of the straight edge of Fig. 8, which is now being tested and perfected by Prof. Stratton, the carriage is about 10 inches long between the points where it bears on the straight edge, a deflection of .01 sec. of the carriage would correspond to an unevenness in the surface of about $\frac{4}{10,000,000}$ inch. In other words, final errors by the use of the interferometer are only about $\frac{1}{250}$ of those remaining after the usual process has been carried to its limit.

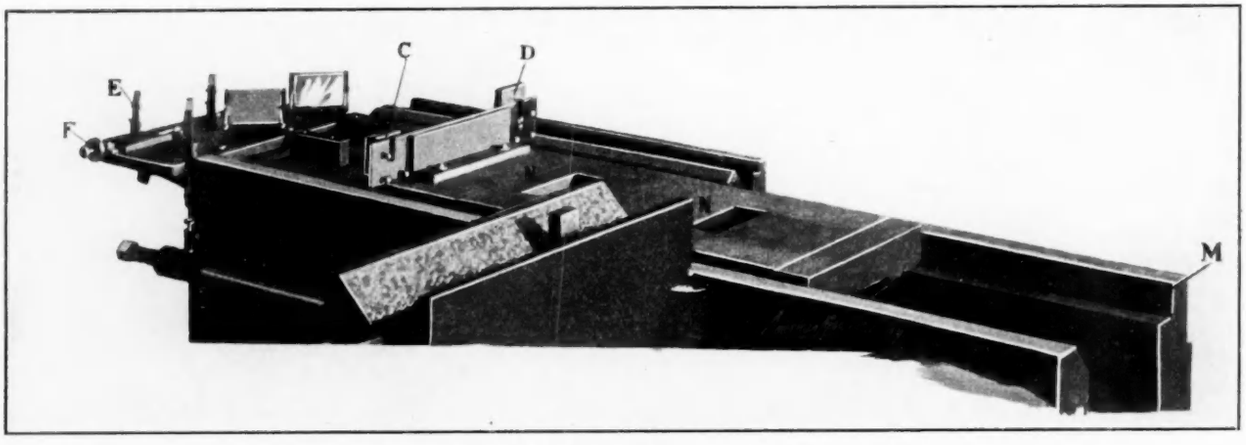


FIG. 8. INTERFEROMETER ARRANGED FOR TESTING A STRAIGHT-EDGE.

The Pan-American Exposition—I.

GENERAL IMPRESSIONS AND CONSIDERATIONS.

The first question asked of one who has visited the Buffalo fair is usually, "How does it compare with the one at Chicago?" and one finds a similar query in his own mind as he approaches the gates for the first time. In magnitude it was not intended to rival the Columbian Exposition, and it does not rival it. In architectural effect, apart from the effect of size, this fair, to say the least that can be said, has nothing to fear from the comparison. The Chicago show had no architectural feature equal to the view down the great central court at Buffalo, while the effect of the illumination at night is beyond any comparison and worthy of all that has been said of it. It is not improbable, indeed, that its equal will never be seen again, as no future fair is likely to have a source of electricity already provided like that from Niagara Falls—for it is from the falls that the current which illuminates the grounds is brought.

In the matter of exhibits this fair has nothing to place alongside those great displays from France, Germany and Italy which occupied so large a part of the Manufactures and Liberal Arts Building at Chicago, and, as a gentleman remarked in my hearing, "the Pan part doesn't seem to pan out very conspicuously." The lesser size of this exhibition is not, however, altogether to its disadvantage. One doesn't have those awful distances to walk that he did at Chicago, and the fair can be seen by a man or woman of ordinary strength and in a reasonable amount of time. The man who cannot find enough of interest to pay him for a visit must have seen much or be hard to please, and no one who can do so should fail to go, especially as the Buffalo people are coming to their senses in the matter of charges for accommodations.

The fair has not so far, in point of attendance, met with the recognition it deserves, and the Buffalo people, as well as the concessionaires of the Midway, are becoming alarmed. Those who have studied the figures relating to the attendance at Chicago are, however, keeping their heads. It is said that 58 per cent. of the attendance at Chicago was during the last sixty days of the fair, and I well remember that at my own visit to Chicago at about the same season that I visited Buffalo, the situation was much the same as in Buffalo—people were beginning to say that the fair was a failure. It is interesting to carry the comparison back further to the Centennial. That fair was looked upon by the whole American people as an event of national importance, and yet, except for the single feature of the great Corliss engine in Machinery Hall, this fair is far and away ahead of it. From an artistic and architectural standpoint, indeed, the achievements of this fair were simply impossible in this country at the time of the Centennial, and yet that fair was held only twenty-five years ago.

The greatest and most interesting single exhibit at Buffalo is undoubtedly that of the government. The executive departments at Washington have certainly learned the secret of exhibiting at fairs, and it is interesting, while looking at the great seacoast defense guns, to remember that for a similar exhibit at Chicago one had to go not to the government exhibit but to that of Herr Krupp.

A NEW LAMP.

Of the private exhibits the most commanding is undoubtedly that of the Westinghouse Electric and Machine companies in the Electricity Building—a 300 horsepower gas engine with direct-connected

220-volt two-phase alternator and 125-400 candle-power Nernst lamps suspended from the rotunda above and lighted from the alternator. Those who are accustomed to associate a miscellaneous clatter with the operation of a gas engine will be agreeably surprised at the performance of this machine, which performs its work with apparently all the steadiness, and certainly all the smoothness and quietness, of a steam engine. The Nernst lamps exhibited are in commercial form, although they are not to be offered for sale until the early fall. They are the first, beyond mere experimental lamps, to be exhibited in this country or, I believe in any other. Prices are not yet given out, but they cannot be otherwise than higher than the usual form of lamp. This, however, is expected to be offset by lower cost of renewal, as the "glower" only will need to be renewed, while the consumption of current is stated to be much lower for a given amount of light, because of the higher temperature at which the glower is worked as compared with the carbon filament. Lamps are shown of 50, 175 and 400 candle-power.

The General Electric Company has also an excellent exhibit, although it has no such striking single feature as the one just described. A complete model of its great works at Schenectady, N. Y., together with those at Lynn, Mass., and Harrison, N. J., is an exhibit that could not be equaled by any other electrical corporation in the world, and is an object lesson of the greatness of this newest of the great industries. The leading novelties of this exhibit are the system of control for railway cars in trains to be used on the New York elevated railroads and a compensated three-phase alternator which automatically secures constant voltage under changes of load.

Across the aisle from the exhibit of the General Electric Company is one by the Niagara Falls Power Company which no mechanic should fail to see. It consists of two models of the plant at Niagara Falls. One shows the external appearance of the plant—the canal or head race leading from the river and the power houses and office building. The other—to a much larger scale—shows a section of the canal, power house, wheel pit and tunnel tail race. The canal contains water, and the ten dynamos and wheels are in position, one of them being a working model driven by water from the canal.

A WONDERFUL CLOCK.

While naming individual mechanical exhibits it is proper to speak of one located where many will not see it and where no one would look for it—in the Midway. I refer to the Gebhard astronomical clock in the Alt Nurnberg Midway show. This clock has at the top the time-honored features of automaton figures performing at the hours and quarters. A child strikes the quarter, a youth the half, a full-grown man the three-quarter, and a skeleton the full hours. At the hour an angel reverses an hour glass and at noon the twelve apostles file in procession before the Savior, bowing as they pass to receive his benediction. As Peter passes a cock crows, and some other special feature, which I have forgotten, signalizes the passing of Judas. At midnight of New Year's eve a door, which has remained closed throughout the year, opens, a trumpeter advances through it and blows his trumpet.

Such features are of course of the nature of mechanical toys, but others are strictly legitimate in a time-keeping machine. The time for ten leading cities is shown on as many dials. Another dial shows siderial time on the twenty-four-hour system, and still another terrestrial mean time on the twenty-hour system. Another shows the length of the day and night, the time of the rising and setting of the sun, and the position of the sun in the heavens, for the place in which the clock is situated, whether the sun be above or below the horizon. This dial in its indication of the rising and setting of the sun and the position of the sun in the heavens is adjustable to suit the latitude and longitude of the place in which the clock may be. The phases of the moon are shown and the amount by which the sun is ahead of or behind mean time. A special dial gives the position of all the principal planets out to and including Saturn. These revolve about the sun, each in his own time, and as the time in which Saturn makes a revolution is twenty-nine years, it follows that one wheel of the clock requires that time for a revolution. A terrestrial globe upon one side and a celestial globe upon the other revolve as they should—the former 365¼ and the latter 366¼ times in a year. The position of the meridian circle in the former marks the noon hour for all places on the earth as they pass under it, while the latter shows the stars which are above and below the horizon at all times as well as the time when they pass under the meridian at the zenith and nadir. A complete calendar is one of the minor features of the clock, and small windows in the base expose the golden number, epoch, solar cycle, dominical letter and the days of the month on which fall the movable holidays of the church. There is also a musical attachment, which I did not hear nor learn the time when it goes off. Finally, this whole machine is driven by a 7½-pound weight, a result which is accomplished through a special escapement invented by the maker of the clock. I could not get a very clear idea of this, but judge it to be of the nature of a remontoir.

ENGINE EXHIBIT.

The protest of the engine exhibitors regarding the unsuitability of their quarters—noted in issue No. 24—has been heeded. The roof has been raised to give ventilation and a floor has been put in, and while the place, as it now is, is not pretty, it answers the purpose. One wonders how any architect could have provided such a place as this must have been before the change.

Perhaps the leading fact which the engine exhibit emphasizes is the passing of the Corliss frame. None of the Corliss or other slow-speed engines have a frame which that great engineer would have allowed anyone to call by his name. I cannot own to a feeling of sympathy for this movement. Not long ago we were wont to look upon the Corliss frame as a stroke of genius—a perfect adaptation of means to end—and to despise the old box bed to which some of those shown are at least second cousin. Of course I know the argument of increasing loads and steam pressures, but I do not see how that justifies putting metal in the wrong place—rather the contrary. Until someone has tried adding half as much of the extra metal to a girder frame that he adds when making some of these miscellaneous types I shall remain unconvinced of the wisdom of some of these changes. It is perhaps not practicable to give the necessary vertical stiffness to a girder frame supported at the ends only, to resist the downward pressure of the cross-head in a long-stroke engine under heavy load, and I can hence tolerate a support under the slides, though under protest. I can even admit carrying the frame to the foundation, as is done by some builders not represented at the fair; but when it comes to taking metal away from its proper position above the center line and putting it outside the connecting rod and down on the foundation, I cannot see how it can be made to earn its keep in its new position.

Another lesson of the engine exhibit is the ever-growing importance of the gas engine and its gradual approach toward perfection in action. In addition to the engine already noted, there is a second one of 300 horse-power, one of 150 horse-power and three of 125 horse-power. Several of these, including the largest, are vertical.

MACHINE TOOLS.

In machine tools there are more things that are new since the Paris Exposition of last year than one would expect—a fact which emphasizes the activity in that line of work. Perhaps the most striking feature of the present line of development is the ever-growing elaboration of machine tools. The designer seems to no longer hesitate to add any number of elements, provided they are individually well tried and provided they give an increased efficiency, and the user no longer hesitates to install such tools. The gain due to automatic tools is now proven and accepted. Gears, levers and clutches, thanks to these same tools, cost but little, and the designer who sees an opportunity to hasten some operation, to quicken some idle movement or to save time in changing speeds and feeds by adding a basketful of

these parts, adds them, and the user does not hesitate to buy the product.

A second line of development, or more properly an example of the line just noted, is the abandonment of cone pulleys and change gears in feed mechanism for nests of gears always mounted in place and brought into action by clutches and levers conveniently placed. This change has also been made in one case in the driving gear of a machine—sixteen speeds of the spindle being obtained by the shifting of levers and with no cone pulley about the machine. A third general feature of recent American practice is the increased use of covers for gears that were formerly exposed. This, no doubt, is an outcome of the sales of American tools in Europe during the last few years.

Attending exhibits at fairs is not usually looked upon as a piece of unmixed joy, but things occasionally happen which lighten the burden of life to an exhibitor. The Gray Planer Company shows one of its planers belted and in constant motion. To show the smoothness of the reversal of the platen, a tumbler of water is kept standing on it, and a young lady, seeing this, innocently asked if the machine was intended for carrying water! A man asked Mr. Gray what the machines were for and was told "to plane iron." "But what do you want to plane iron for?" was the next intelligent question. After some pondering for an illustration suited to his questioner, Mr. Gray explained that the boards used by a cabinetmaker came to him with rough sawed surfaces and it was necessary to make them smooth by planing. These machines, he then explained, were for doing similar planing on cast iron. "But," said the questioner, "do you mean to tell me that you are making furniture of cast iron?" At the Brown & Sharpe exhibit is a small automatic screw machine at work making small brass screws and using lard oil on the tools. This oil has been used enough to have acquired a slight green color from the brass, and as the work is small and the speed high, some of the oil is beaten into a froth which accumulates at one end of the drip pan. This greenish froth does look not unlike pistache ice-cream, and a sweet young thing in pink asked if the machine was a new kind of ice-cream freezer.

F. A. H.

Correct Form of the Sellers Friction Disks.

A Western correspondent has asked for the "proper or most efficient angle for the Sellers friction disks." The inquiry was referred to William Sellers & Co., whose reply is given below. We have laid out the accompanying skeleton diagram, which will assist in making the matter clear. In Fig. 1 the clamping disks are midway between the driving and driven disks, the speed ratio being 1. In Fig. 2 the clamping disks are raised toward the driving disk to give an increased speed. It will be observed that the contact is the same in both cases and that the center lines of the clamping disks tilt as the disks are raised in such manner as to keep the centers of the surfaces on the original center line for all positions of the disks.

Editor American Machinist:

In reply to your inquiry as to the proper angle to which to turn the Sellers friction disks, we may say that no angle can give a proper shape. The driving and driven disks should have a narrow rim bearing turned concave and the clamping disks are turned convex, the surface of the latter being thus a portion of a sphere, the center of which is located on a line coincident with the axis of the clamping disks and midway between the peripheries of the driving and driven disks. The radius of this spherical surface is from 11 to 12 times the diameter of the clamping disks, and the rims of both driving and driven disks are formed from the same center, consequently the clamping disks in all positions fit the surfaces of the rims, and a constant width of driving surface is obtained.

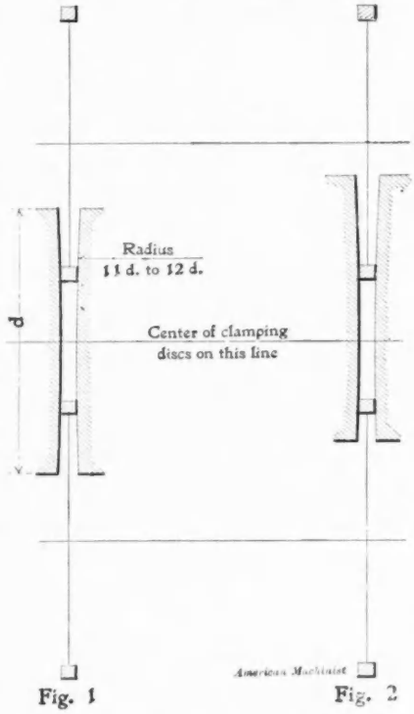


Fig. 1 Fig. 2

LAYING OUT THE SELLERS FRICTION DISK.

WM. SELLERS & CO., INC.
Per J. SELLERS BANCROFT.

Table of Formulas for Bevel Gears.

The feature of the accompanying table is not the novelty of the formulas themselves, but that they are so arranged that any time a bevel gear has to be figured up the draftsman is "on to" it without a moment's hesitation as to how or where to begin. By giving the calculations an orderly sequence they are easily checked by the other fellow without a preliminary explanation of the line of attack. Then again, on these lines one can refer back to previous reckonings with confidence.

With the exception of the alternative formula No. 1_2, which is a trifle shorter than No. 1_1, all the formulas can be seen through in a moment by anyone who remembers that in Fig. 1

$$\sin.\ \alpha = \frac{\text{perpendicular}}{\text{hypothenuse}} = \frac{P\,N}{O\,P}$$

$$\cos.\ \alpha = \frac{\text{base}}{\text{hypothenuse}} = \frac{O\,N}{O\,P}$$

$$\tan.\ \alpha = \frac{\text{perpendicular}}{\text{base}} = \frac{P\,N}{O\,N}$$

bearing in mind, of course, that if the complementary angle, formed by sides $O\,P$ and $P\,N$, were under consideration, the perpendicular for that angle would be $O\,N$ and the base $P\,N$. However, to use the formulas even this smattering of trigonometry is not essential; all that is needed is common sense enough to use a table of trigonometrical ratios—of which there can be none more complete and clear than those appearing in Brown & Sharpe's "Treatise on Gearing and Formulas in Gearing."

The trigonometry referred to—though it is hardly enough to deserve the name—is sufficient for the majority of practical calculations. It certainly would not allow short-cuts, but unless one is frequently using trigonometry it is safer and much easier to calculate only on these very elementary lines. As for speed, here we have a striking case that the longest way round is the shortest way home—*verbum sap.*

Harking back to our formulas, the lettering adopted does not clash with the Brown & Sharpe references in their tables of tooth parts. As to the phraseology, alternative titles are given which for the most part indicate the respective American and English terms. The first title in each case is the one preferred by the writer, who, it will be seen, favors in turn those peculiar to Brown & Sharpe and G. B. Grant as well as the recognized English ones. The term "excavating angle" is used by Smith & Coventry, Manchester, and is certainly a suggestive one.

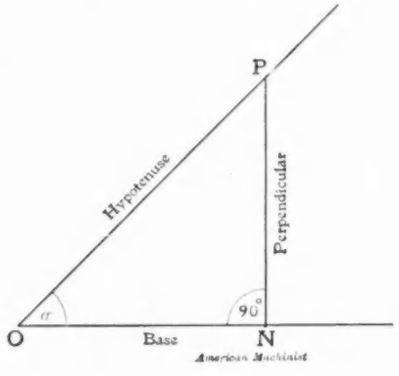


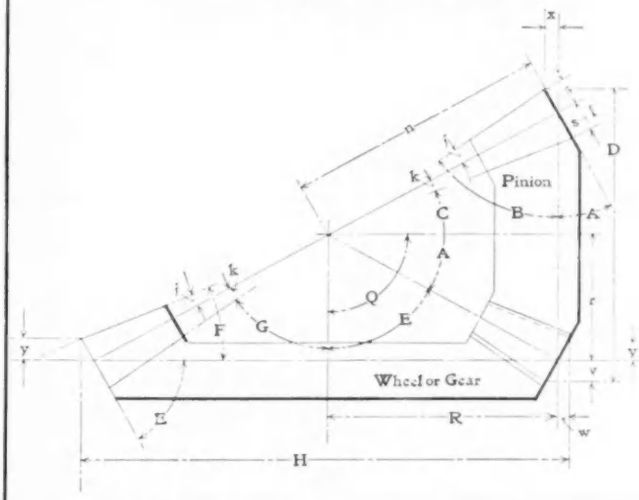
FIG. 1.

EDWARD T. ELBOURNE.
Birmingham, England.

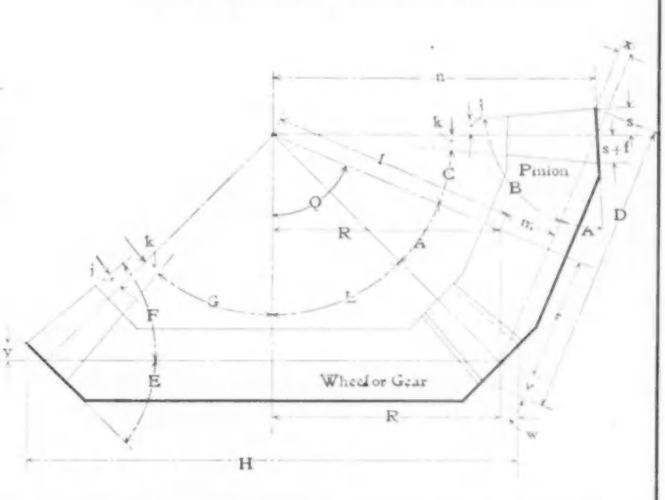
A Too Frequent Railroad Shop Experience.

During a recent visit to the shops of one of the great trunk lines of the country, the writer was surprised to find that although all the men he met were intelligent and progressive in their ideas, he could discover no evidence of the application of these ideas in the adoption of modern methods of organization and management in the shops. Machinery and tools were old, and evidently the work they were doing was costing much more than it could have been done for elsewhere. On inquiry for the cause of this condition of affairs, the blame was laid on the Board of Directors, which, they said, looked upon the shops as a necessary evil and merely tolerated their existence, cutting down the amount of all appropriations asked for for new equipment. The superintendent of machinery said that after many futile endeavors to obtain an outfit of air-compressor and pneumatic tools, which are now the necessary adjuncts of every modern shop of the kind,

Case I - When Gear Axes are at 90°



Case II - When Gear Axes are at less than 90°



		ESSENTIAL DATA.
	Q	Angle of Axes of Gears
	r	Pinion Pitch Circle Radius
	R	Wheel or Gear Pitch Circle Radius
	s	Addendum, Point, or Height of Tooth above Pitch Line
	s+f	Root or Depth of Tooth below Pitch Line

Formula No.		WORKING VALUES.
1 or 1	A	Pinion Pitch, or Centre, Angle
		" Edge Angle
4	B	" Face, or Outside, Angle
5	C	" Cutting, or Excavating Angle
6	D	" Outside Diameter
7	E	Wheel Pitch, or Centre, Angle
		" Edge Angle
8	F	" Face, or Outside, Angle
9	G	" Cutting, or Excavating Angle
10	H	" Outside Diameter
		INCIDENTAL VALUES
2	j	Increment, or Top, Angle
3	k	Decrement, or Bottom, Angle
1a & 1b	l+m	Pinion Axis Length to plane of Pitch Circle
2a	n	Apex Distance from Pitch Circle
6a	2 v	Pinion Diameter Increment
10a	2 w	Wheel Diameter Increment
		SUPPLEMENTARY VALUES
11	x	Pinion) Distance from top of Tooth
12	y	Wheel) to plane of Pitch Circle

1	To find A—value l + m reqd Case I — l + m = R (1a) $l = \frac{R}{\text{Sin } Q}$ $\text{Tan } A = \frac{r}{l+m}$ (1b) $m = \frac{r}{\text{Tan } Q}$
1	Case I $\text{Tan } A = \frac{r}{R}$, Case II $\text{Tan } A = \frac{\text{Sin } Q}{\frac{R}{r} + \text{Cos } Q}$
2	To find j—value n reqd $\text{Tan } j = \frac{s}{n}$ (2a) $n = \frac{r}{\text{Sin } A}$
3	$\text{Tan } k = \frac{s+f}{n}$
4	$B = 90° - (A + j)$
5	$C = A - k$
6	To find D—value 2 v reqd $D = 2r + 2v$ (6a) $2v = 2s \text{ Cos } A$
7	$E = Q - A$
8	$F = 90° - (E + j)$
9	$G = E - k$
10	To find H—value 2 w reqd $H = 2R + 2w$ (10a) $2w = 2s \text{ Cos } E$
11	$x = s \text{ Sin } A$
12	$y = s \text{ Sin } E$

American Machinist

TABLE OF FORMULAS FOR BEVEL GEARS.

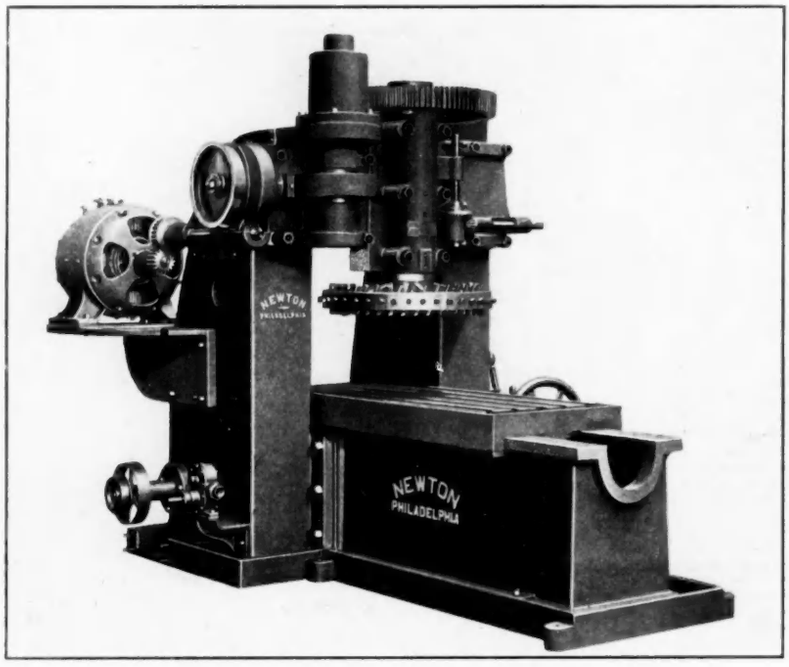
he had actually started in to build the whole thing himself. He said it would cost the road ten times what it could be bought for and take a long time to complete, but that the road would save money over present practice. It would seem as if in this case a "getting-together" of the powers for a full discussion of the situation would have uncovered the mattoid and that his usefulness to the road would in the future have been diverted in another direction.—H. F. J. PORTER, before the American Water Works Association.

Vertical Rotary Planer.

The accompanying half-tone illustrates a new special tool which may be called a rotary milling machine or a vertical rotary planer, as the reader prefers.

The machine was built by the Newton Machine Tool Works for the General Electric Company, its intended purpose being the facing of the joints of street car motor frames.

The cutter head is 30 inches in diameter, the distance between uprights being 36 inches. The machine will mill a cut 6 feet long.



VERTICAL SPINDLE ROTARY PLANER.

The drive will be seen to be from an electric motor through a train of spiral and spur gearing. The flanged gear meshing with the pinion on the motor shaft is of raw hide—the object of introducing gears at this point being to permit change of speed. The table is driven by a rack and spiral pinion, the motion being obtained through the flanged pulley at the top of the housing and one of the pulleys near the bottom of the housing—the second pulley at this point being used to drive the lubricant pump which is seen alongside, but without its pulley.

For the special work which the machine is to do but a limited range of vertical adjustment of the cutter head is needed, and this is provided by the spindle slide, the cross-rail being fixed to the housings.

The machine will be seen to be surrounded by a drip pan, cast with the base for returning all lubricant to the pump. A well or pot, not shown, will be sunk in the foundation to give a suitable storage capacity for the lubricant.

Our readers will not fail to observe the correct setting of the cutters in the head. It is a constantly recurring source of surprise to us to see such heads made with the tools set parallel with the spindle, without top rake, and adapted to do no better service than push off the metal as best they can.

Echoes From the Oil Country.

FILLING A LONG-FELT WANT.

It seems as though our corn shellers must fill one of those long-felt wants we sometimes hear about, as we seem to get rid of a good many. We make large ones and small ones, for boy or man or any other available power, single or double crank; so you see we have quite a variety. We didn't really want to make such a variety, but we just got pushed into it somehow. When anybody comes around wanting something, and you are not doing much and he is waiting to pay for it, you are pretty apt to make it if you can.

I wish now I could begin all over with my experience. The first corn shellers that we made went to all sorts of people and got all sorts of usage, and mis-usage, too. For the sake of my personal vanity I am pleased to note that a few things didn't have to be changed, but for a while every lot was changed more or less. Then I was just green enough to send them out without marking them; just thought a man should know a big one from a little one, etc. Before I got through with it, however, this matter of marking them got to be serious.

Somehow the fellow that has the greatest faculty for smashing things seems to have the least for telling just what is broken. To cast numbers on the parts seemed simple enough, having the same number represent the same piece on every sized machine, and then put a letter on, each size to have a different letter. Then the question soon came up: Shall we throw the casting away when the letters and figures are bad, or the molder slicks them off? If we did that the profit would go with them. We will have to hope the fellow who gets a machine with missing numbers will never need parts.

To help out some on this line I took to stamping a number on the end of the crankshaft, beginning with 1 and going up consecutively without regard to size or style of machine, numbering each one as it was finished, and then marking down in a book with the number the style and to whom sold.

All this would be very well if it wasn't for several things. In the first place there are numerous changes to keep track of on each style and size. Then most of the people seem to think that we must surely know all about their machine, and they don't give figures, numbers or letters.

Just imagine a youngster rushing in with "Say, gimme that piece that goes round, like this here" (waving his fingers in the air). "What's it for? why, for that there corn sheller, of course—and be quick, too; I want to get back home before all of them hens starve to death and quit laying and the price of eggs goes down." Or an older one coming for it with "Why, I don't know just exactly what it is, but you made the thing and had ought to know all about it." With this you receive a look of mingled reproach and suspicion that makes you wish you only made one size and one style and that it only had one piece. Even then he would likely knock off a corner and want to be supplied with a new corner to fit the place without being able to tell which corner or the shape of the break.

Of course you may make him bring the broken piece or the whole thing to the shop for repairs and let his pigs and chickens wait until he gets back; but we have set out to make things convenient, and that would hardly do, so we, in extreme cases, let them take a new one and return the old one for repairs, and then make another swap. This fills the bill, but makes too much handling, and then when the new one gets back it is second hand; so, to avoid that, we sometimes just trade for keeps and keep the repaired one for the next comer, when he is in too big a hurry to wait for repairs.

To keep up sizes to some kind of a standard, so that parts could be made in lots and repairs could be made by throwing out one piece and putting in a new one, I soon found we must have some way of keeping our sizes. Brown & Sharpe and Pratt & Whitney make some very nice things for this purpose; but, you see, Mr. Smith very naturally did not see the need of putting money into such things, while my private pocket book could hardly stand the strain. But gages I must have, and so I had the blacksmith forge me some, which I filed up and hardened and with the oil stone brought to as near size as I could, measuring from a scale.

I didn't have as much confidence in scales as perhaps I ought, and it came about this way. We make couplings sometimes, flange couplings that bolt together. I struck the idea to make them to standard, and where they fit together I made them 6 inches, thinking that an easy size to duplicate, as every man owns a 6-inch scale, and the calipers could easily be set to the full length of it. We had made several, and they went together nicely, and I felt pleased. One day I went to put a pair together and I found them a very loose fit. Different men had made the pieces. I went to the first one and asked how he got his size; he promptly produced his scale and said that was his standard. Then I concluded the other chap was off, and I went to him, and he also claimed to have used his scale for his standard. I called them together with their scales and we tried the pieces and found they were stating facts. The scales did not look worn, but were of different makes, and the difference was enough to make a poor fit. Remembering this, I turned up some pieces to fit my snap gages and put them away. I also notified the men that, as far as cornshellers went, the sizes stamped on the gages were the only true, good, reliable and official sizes in the shop of those dimensions, and that I would translate anyone found trying to hammer the gages to suit his work. I had ground and polished them so that I could see a hammer mark without much trouble. I think that fellow who was cracking nuts with one knows better now, or should.

I hope some day to get a chance to go through Brown & Sharpe's and Warner & Swasey's shops and see how they do all this nice work. I know they do it. In the meantime, should any of them come our way I would be glad to show them around. I think I could show them more away from the shop, though, than in it.

There is one disagreeable thing I have had to do. Every once in a while someone will come in and tell me I should make some change to suit his fancy. Often he is not a user of the thing, and doesn't intend to be, but he just wants to give me the benefit of his ideas. If I followed all this kind of advice I would never have two lots alike. The worst of it is, most of these people haven't mechanical training enough to figure out the proper strength of a good, economical pig pen.

Don't I know that a part isn't any too big that I have enlarged three times already to get it so it wouldn't break? If it is too small in the other place, why doesn't it ever break there instead of at this place they think is too big? Those bearings are big enough as long as they last as long as the rest of the machine. When the machine told me it wasn't right I listened, but I won't listen to my best friend in these matters unless the machine sings the same song he does.

I am not much of a seer, but, as it is, just by keeping things improved as they should be, I can, by shutting my eyes and thinking of the time when they will be in every home in the land, see the hillside covered with buildings used to keep the tracings and patterns and gages and records and other things necessary to fill orders for parts, and try to number the army of clerks necessary to keep track of it all.

I have thought of several ways to avoid this, but have not yet decided whether it would be cheaper to give a new machine for an old one or have a law passed making it a misdemeanor to want parts for a machine more than five years or ten years old, or whether I had better get up a company and sell out and leave.

Perhaps the easiest and most natural way may be to not get too large a business, or else get the corn-shellers so good that they will last always, or when they do wear out all go at the same time; then they won't need repairs.

I am aiming at both of these last two ends. I used to wonder why some machines were still being made that were made long ago; but I am beginning to see what changes mean. If all the improvements can be got together and put into a new machine there will still be some who would rather have the old one; thus there are two types. To keep them separate, build an addition, then from the experience gained build another type; that may mean more shop. This may not be just how it works in the cities, but it seems to tend that way out here. W. OSBORNE.

Smokeless Furnaces in Germany.

United States Consul-General Richard Guenther writes from Frankfort as follows:

"A German imperial commission has been making experiments in the consumption of coal dust in furnaces, and a recent report makes special mention of the "Schwarzkopff" apparatus. The Journal of the Society of Arts has also given a brief description of the same. It states that it is necessary in the first place to have a highly heated fire chamber for the ignition of the coal dust, for the higher the temperature the quicker and more perfect will be the combustion. Contact with the boiler walls must be guarded against, as this interferes with ignition; the fire chamber must be lined with fireproof material, as it has to be kept constantly at a certain temperature. It is pointed out that such a fire chamber is not an inconvenience but rather a special advantage in coal-dust firing, because it insures perfect combustion, a high temperature of the gases at the start and protection against the formation of "needle" flames. Also, after firing has ceased—for the night, for instance—the heat stored in the fireproof walls maintains steam pressure longer and steam is more quickly raised in the morning.

"The managers of state institutions have been instructed to do all they can to prevent or to consume the smoke from their fires,and, if necessary, to have smoke-consuming appliances constructed. Municipal authorities have been asked to do the same. It would seem a propitious time for American builders of smoke-consuming devices to appear on the field. I think it can easily be demonstrated that at least some American devices successfully prevent the formation of smoke and make it possible to use low grades of coal, screenings and dust, so that the cost of the plant is covered by the saving in the cost of fuel in two years. It seems to me advisable for our manufacturers of smoke-consuming furnaces to have experts investigate conditions here. I am convinced that a large and lucrative business can be established."

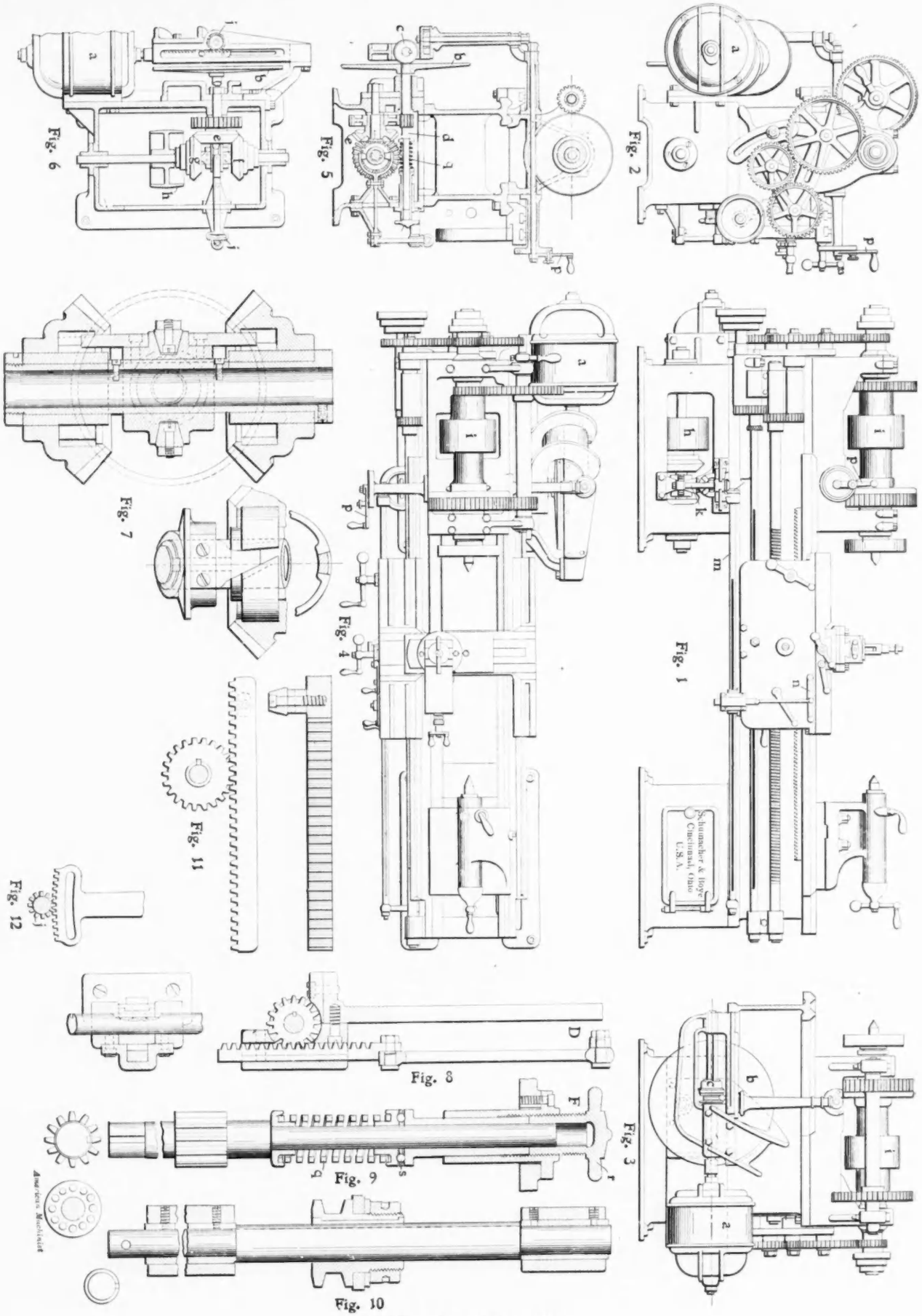
Cheapening and Improving Tin Plate Manufacture in Wales.

Consul Griffith W. Prees, writing from Swansea, Wales, tells as follows of the great changes in tin-plate manufacture since American competition has been waking up the proprietors in that industry:

"During the past five years methods of work in the tin house or finishing department have undergone a complete change and the coating of the black-plate sheet is now done in an entirely different manner. Formerly, a tin man, wash man, greaser, cleaner and duster were employed to coat and finish the black plate; the work is now effectively done by a tinning machine, manipulated by a tinman and a boy.

"Following is a description of the method of operating these tinning, cleaning and dusting machines:

"The tinman places a wet black-plate sheet in the tinning pot, which contains a chemical compound called 'flux'; from this receptacle the sheet, by means of guides and rolls, which I shall call rolls No. 1, passes through a bed of molten tin. Then, by means of guides and rolls No. 2, the sheet is conducted to a grease pot, which is a bath of hot palm oil. From this bath the sheet, now thoroughly coated, emerges between three pairs of rolls No. 3, and is transferred by the boy to the cleaning machine. In the cleaning ma-



ELECTRICALLY DRIVEN LATHE.

chine the tinned sheet is conveyed by small rollers through layers of bran, and all grease or oil spots are removed. The sheet is finally placed in a dusting machine. This last is a very simple affair, consisting of three or more pairs of rollers covered with sheepskin, between which the sheet passes. The latter is then ready for the assorting room.

"This method of coating and finishing tin plates is a great improvement on the old style. In addition to saving time—the whole process occupying but a few seconds—labor and expense, the finished article is better. It bears a clearer and more uniform surface; the 'yield' also is greater, an average of about 2 pounds of tin being used per standard box of plates.

"Notwithstanding the extensive improvements, Welsh manufacturers still find competition keen, and a new workmen's wage list is under consideration to replace that of 1874. This means a reduction in wages of from 10 to 70 per cent."

Electrically Driven Lathe.

The accompanying illustrations show a lathe called by its makers a self-contained lathe, because of its having no countershaft and carrying its own motor.

The motor is located at *a*, Figs. 2, 3, 4 and 6. The motion is carried from this motor through the friction disks *b c*, Figs. 3, 5 and 6, to a cross shaft *d*, Fig. 5, from which, through a pair of spur gears, it is carried to bevel gear *e*, Figs. 5 and 6, which engages with two other bevels *f g*. A clutch, shown in detail in Fig. 7, between *f* and *g* may engage either one and so drive the lathe in either direction. On the shaft carrying *f* and *g* is a belt pulley *h*, Figs. 1 and 6, which belts directly with pulley *i*, Figs. 1, 3 and 4, which occupies the position of the usual headstock cone and which is back-geared in the usual manner. The bevel gear clutch of Figs. 6 and 7 is operated through the segment and rack *j*, Fig. 6, the vertical shaft *k*, bevel gears *l*, splined rod *m* and lever *n*, Fig. 1, the starting, stopping and reversing of the lathe being thus done at the apron. The details of the connection between splined rod *m* and lever *n* are shown in Fig. 8.

The clutch, Fig. 7, contains a very neat feature. The central sliding sleeve is splined to the shaft and carries a wedge projecting in each direction. These wedges enter split bushes within the gears and expand them to tighten the clutches. The feature referred to is the disposition of the angles of the wedges. The split sleeve of the plan view of Fig. 7 drives in the direction of the arrow and the effect of the pressure of the driving side of the split upon the wedge is obviously to retain it in engagement, instead of pushing it out of engagement, as would be the case were the two sides of the wedge symmetrical with one another.

The speed of the machine is varied through the friction disks by sliding one of them lengthwise on the motor shaft, this being done through rack and pinion *o* which are connected through shafts and bevel gears with the hand crank *p* located on the headstock and shown in Figs. 1, 2, 4 and 5. Friction disk *b* is pressed against its mate by a spring *q*, Fig. 5, the tension of which is adjusted by the star hand wheel *r*. This arrangement is shown to larger scale in Fig. 9, from which it will also be seen that the thrust of the spring is taken by a ball step bearing *s*. Other features show further details.

This arrangement is applied by the makers—Schumacher & Boye, of Cincinnati—to their 16, 18, 20 and 22 inch lathes.

Casting a Housing for a Saw Mill.

BY R. H. PALMER.

The casting to be made is shown in Fig. 1, the pattern being the same with core prints added, which are shown in Fig. 2 and marked *C*.

The pattern, minus the foot strip *J*, shown in Fig. 3, and bosses *P*, is laid on a plain mold board, care being taken that the mold board is put down true, and not winding. If your mold board is winding, you may expect a winding casting. The pattern is faced with a sea-coal facing, mixed one of sea-coal to ten of sand for the outside. The mixture for the inside, on the plate part of the casting, is brought down to one to twelve. The casting is about 1 inch in thickness, and, there being quite a large plate to cover, better results can be obtained by the latter mixture, as there is then less danger of cold-shut, and

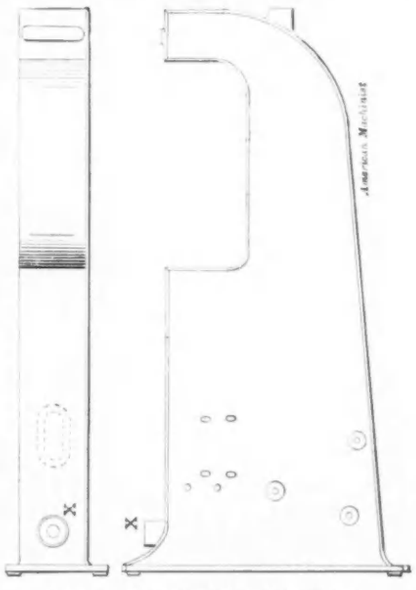


FIG. 1. THE CASTING TO BE MADE.

it will be found plenty strong enough to peel the casting.

The core *B*, Fig. 3, is placed against the foot of the pattern, the pattern is faced, and, the drag being in place, the ramming is begun. When the sand is first thrown in, it is tucked around the gatesticks *F* to hold them in place. When the outside has been rammed up to the point where the gate cores *B* are to rest they are placed between the gatesticks *F* and the pattern, so that the opening in them, or the gate, will connect with the gate formed by gatesticks *F*.

It will be seen that the inside of the

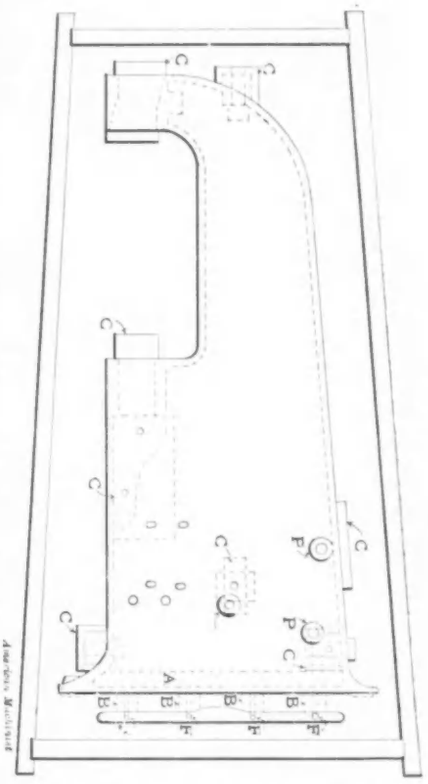


FIG. 2. THE PATTERN IN POSITION.

pattern forms a mass of sand some 11 inches in depth, and any molder knows he can draw gas up in a mold more easily than down, that when drawing the vent or gas underneath a body of sand like this which is surrounded by the iron and where the iron also flows over the top of it, ways must be provided for the gas to escape easily and quickly. If it does not, scabs on the plate part of the casting are the result.

The sand having been rammed to a hight of some 8 or 10 inches on the inside of the pattern, the inside is given a good venting; but don't try to run your vent wire through the pattern every time you stick it into the sand. The pattern don't look any the better for it and the gas is to go the other way.

Broken coke or cinders, *A*, Fig. 3, are now spread over the vents to a depth of 2½ inches or so. The cinders are covered with paper. Large gatesticks are connected with them, and the whole is rammed up to the top of the drag and struck off. A channelway is now cut from the gatesticks to the side of the flask, the gatesticks are removed, and small cinders are filled in and are run from these gatesticks in the channelway

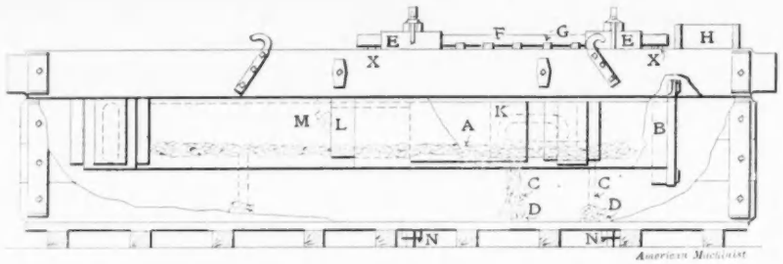


FIG. 3. LONGITUDINAL ELEVATION OF MOLD—PARTLY IN SECTION.

to the side of flask, to either connect with a hole bored in the side of the flask or provision is made for the gas to escape between board and drag *C D*. Most of the flasks in use in foundries have quite enough places burned out in the drag near the board, so new holes will not have to be bored. The board is now rubbed to a bearing and clamped on and the whole rolled over. The cope is placed on at the proper time and rammed up, but the facing used on the pattern is not stronger than one to twelve. The cope being hoisted off the foot-piece *J* is drawn out and also hubs *P*. The pattern being drawn and the mold finished the cores are set.

It will be seen by referring to Fig. 1 that a round hub or boss *X* sticks out on the side. As it would be somewhat awkward to cope down so far on the side of the pattern, a coreprint is put on the pattern over it, extending down to one-half, or the middle of the round, and bearing enough is left on each side and back to support the core. Also on the back of the pattern, *K*, Fig. 3, there is a round put on the casting around the slot hole in the side; this round is also formed in the core *C*, Fig. 2. The cores being set, the vent is brought from the main core *L* by a pocket of cinders *M*. It will often be found that

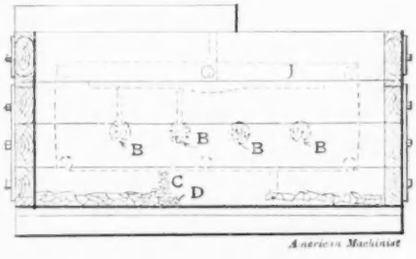


FIG. 4. CROSS SECTION OF MOLD.

a vent can be brought off by using a pocket of cinders in some such way. Should the iron find its way to the cinders, if it runs among them, it will usually chill in such a way as to leave an open vent. The half-tone, Fig. 6, will show how the core B at the foot of the mold is fastened by the use of nails or spikes. At different points, *X*, will be seen small pieces of clay which have been rolled round, a little longer than wanted, and then stood on end at the points where it is wished to locate a chaplet. A little flour is placed on top of it as the cope is hoisted off, when it has been tried on; an impression and white spot is left on the face of the cope at the spot where the chaplet is wanted.

In Figs. 4 and 5 will be seen the binders *F* running lengthways of the flask to hold down the chaplets and wedges over the bars, also the cross-binders *N*, which are bolted together to hold binders *F* down. As the plate of the casting is several square feet in area there is quite a lifting surface.

A casting like the above requires to be firmly rammed around the outside, yet the surface on which the iron is to lie to form the plate will not stand to be as hard as the sides of the mold. The sides are easily vented by running a row of vents around the pattern from a channelway cut around it, or by using a long vent wire and running it down to the bottom board before making the joint; but the inside of the casting is what will show just how much care is taken in providing for an easy escape for the gas, for if the venting there is not properly done and the escapes not sufficient there will be enough scabs to show it.

In making gate cores a core-box can be used and the gate cut in each half of the core and then the core wired together if need be after pasting. Of course in large castings requiring special gate cores special core-boxes may require filling up. The casting is some 12 feet high by 4 feet 10 inches wide on the plate and weighs some 3,700 pounds.

The object in placing a core like *B* in the foot is to have the iron strike against when it enters the mold, and not against the green sand. Often the iron striking directly against the green sand will cut it, or wash it, and this is done as a safeguard.

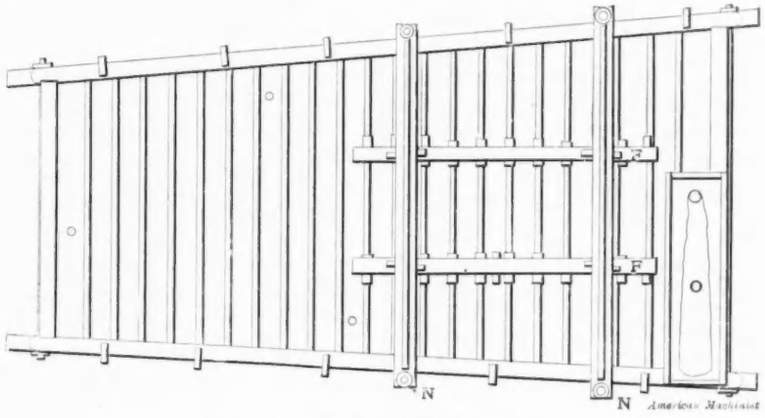


FIG. 5. TOP OF MOLD COMPLETE.

A Jig for Accurately Drilling a Plate.

BY JOSEPH V. WOODWORTH.

The cut gives three views of a jig for drilling the four holes in the plate *A*. This plate is of tool steel, finished all over and accurately ground to gage. It is a part of a delicate attachment on a type-casting machine. Before starting on the jig the holes in one of the plates were carefully located and drilled in the universal milling machine by the use of the Brown & Sharpe hight gage and vernier calipers. With the plate as a master templet we were then ready to go ahead with the jig. This jig consists of a body casting *B* with raised strips cast on the inside at *D D* and a projecting lug at one side for a fastening

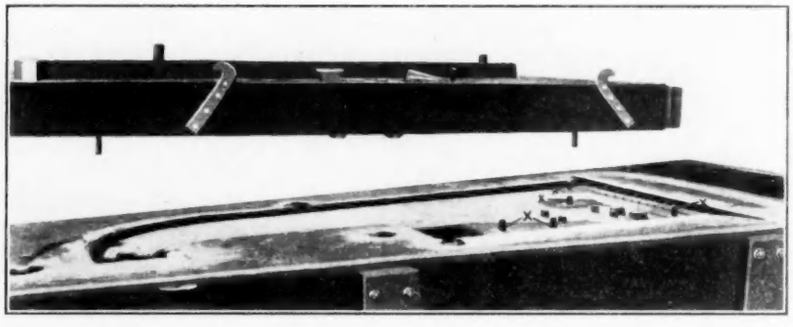
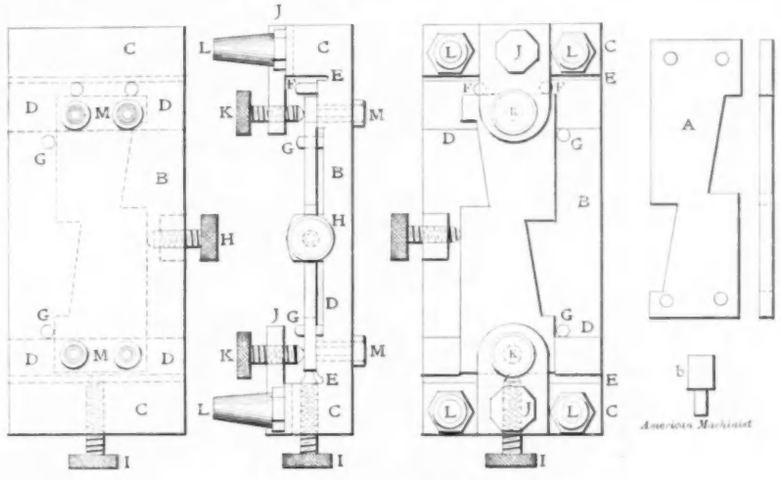


FIG. 6. MOLD WITH COPE LIFTED OFF.

screw. After the body casting was milled all over and squared, the four legs *L* were made of tool steel and their ends hardened. They were screwed tightly into the casting *B* and their faces lapped square with the sides and top of the casting. The master templet *A* was then clamped securely within the jig, and holes were drilled for the four locating pins *G G* and *F F*. The plate was then removed and the pins, which were of Stubs steel, were driven tightly into the holes. Holes were then drilled and tapped for the fastening screws *I* and *H* respectively. The master templet was then clamped by these screws in position in the jig. A special drill was then made to fit snugly the reamed holes in the plate *A*, and the holes were carefully transferred through the plate and into the jig, drilling straight through to the face. The plate was then removed and the four holes drilled in the jig were reamed to an exact size. A plug or button *b* was then made with the stem ground to fit snugly the holes drilled in the jig and the larger part ground true with the stem.



JIG FOR DRILLING PLATES.

The jig was then strapped on the faceplate of the lathe, face outward; the button *b* was entered into one of the four reamed holes and then accurately located central by an indicator. The button was then removed and the hole was enlarged and reamed to the size required for the drill bushings. The operation was repeated until all four holes were finished and reamed to size. The four drill bushings were then driven tightly into the holes. An extension piece *J*, of flat machine steel, was then fastened on the bottom of each end of the jig and drilled and tapped for the fastening screw *K*. The jig was now complete and ready for work.

When in use, the plate to be drilled was slipped into the jig and faced against the side locating pins *G G* by the screw *H* and against the end pins *F F* by the screw *I*. Then by tightening the screws *K K* it was held firmly. The four holes were then drilled, the finished piece was removed and another inserted in the same manner. Although the work produced in this jig was required to be very accurate, the jig itself is of a very simple design, and does not require unusual skill to make.

Letters from Practical Men

Always Ahead and Always Behind.

Editor American Machinist:

I suppose the hardest job of the engineer is to catch up with himself. I mean here the big engineer, or, if you please, *the* engineer, the fellow who lays out the mechanical work of the world and who plans the ways and provides the means for doing it. Too often he can look over a good job done and congratulate himself upon the success of it, and at the same time be kicking himself because he sees that he must almost immediately begin to do it all over again, and as differently as possible from what he has just finished. "Why didn't I think of that before?" he is constantly asking himself, with never a satisfactory answer. It would be a rather discouraging experience only that the engineer is always in the best of company, for statesmen, philosophers, theologians—all the big men, except perhaps walking delegates—do their work in the same way.

We have one of the best illustrations of this in what is perhaps the biggest and most enduring problem of the modern engineer, that of urban and suburban transportation. In New York city we will soon have overhead, underground and surface systems in full operation, with also water conveyance wherever possible, and no one can look forward to the time when the ever-growing requirements will be more than temporarily satisfied. A peculiarly interesting illustrative case is that of the Broadway cable system of surface transportation. It has taken only a single decade to see that system installed at great expense, to have it run its course and then to be swept out of existence. When the cable was laid down it represented the best wisdom of the engineers of the time. I know the electrical engineers are coming out now with their I-told-you-sos, and asserting that they protested at the time against the adoption of the cable system, but it is the fact that no system preferable to the cable and conforming to the conditions of New York city traction had then made out its case and established its right to the preference. After the cable was in full operation in the city experiments were begun with the under-trolley, and they had to be continued for a considerable time before the safety, reliability and economy of the new system were demonstrated. The demonstration was finally completely convincing and then the work of changing it all was soon begun, and to-day there is not a yard of cable in use in New York, but we have in place of it the most perfect, the most satisfactory, the most magnificent system of surface transportation in the world. About this matter I am not in the slightest doubt, and no one can watch the operation of the eight or ten lines now traversing the length of Manhattan Island without admiring the engineering success embodied. It is a curious thing that slowness or conservatism, or whatever it may be called, has had much to do with securing the success I speak of. The overhead trolley was of course anxious enough to take the job when the cable was put in, and if it had been permitted we might have been under its network of wires today. It was not allowed, and we may all be thankful.

And now, what next? The under-trolley may have a longer life than the cable had, but who can believe that it or any modification of it or improved type of it can be final? There will be some more millions of dollars' worth of scrap to be thrown out one of these days. While we are rightfully boasting of the most perfect installation in the world we are still very conscious of some important requirements that are not satisfied. The car is still as dependent upon the power house as the cable car was. Only a few days ago there was a slight accident to the line of the Brooklyn system, and in an hour and a half about fifty thousand people walked over the bridge.

Evidently the first thing now called for is the independence of the car or other vehicle as to the power supply. It must be able to move without maintaining a constant connection with any power house. As we have thrown away the cable so, it would seem, must we yet throw away the electric wire. The car must be self-contained and entirely able to move of itself for a certain length of time at least. When the constant connection, electric or other, is no longer a necessity what need have we of the track? The original function of the track has been in the meantime annihilated. The track of the horse car, which enabled it to supersede the omnibus, was only of service because it re-

duced the friction and enabled the vehicle to be drawn more easily. Now, with asphalted streets, roller bearings and pneumatic tires, we can run anywhere more easily, and at less tractive cost, than the best of the old horse cars on the best of tracks.

Whatever at the present moment may be the apparent status and promise of the automobile or the autocar, or whatever we may choose to call it, we cannot find it difficult to believe that it is the coming vehicle for surface transportation, both for individual use and for the biggest of the city transportation or traction companies. It behooves the big corporations to be looking out for themselves by the fullest investigation of and experimenting with the most promising of the independent motor vehicles, for that is what they are very likely to have to come to. It may be more than a mere coincidence that with the funeral of the cable we have the announcement of important and valuable improvements in the storage battery. That may be the herald of another great advance in the direction here indicated, and New York city, which, to its great ultimate advantage, would not admit the overhead wire, may one day insist upon the removal of every car track from its streets and avenues. TECUMSEH SWIFT.

Suspending Hose for Traveling Air Hoists.

Editor American Machinist:

Enclosed we send you a photograph and line drawing showing two methods of supporting air hose which are in use in our works.

Fig. 1 shows our old plan. At *a* is a cross-section of the track, on which run two trolley wheels, one of which is shown at *b*, and which carry a bent piece of iron having at its lower end a clamp *c*.

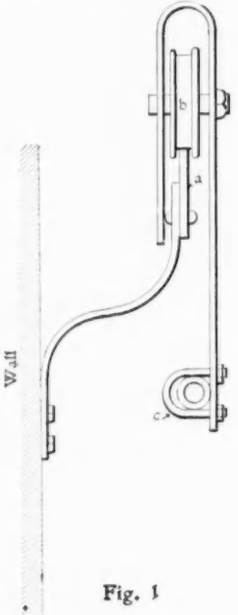


Fig. 1

METHODS OF SUPPORTING AIR HOSE.

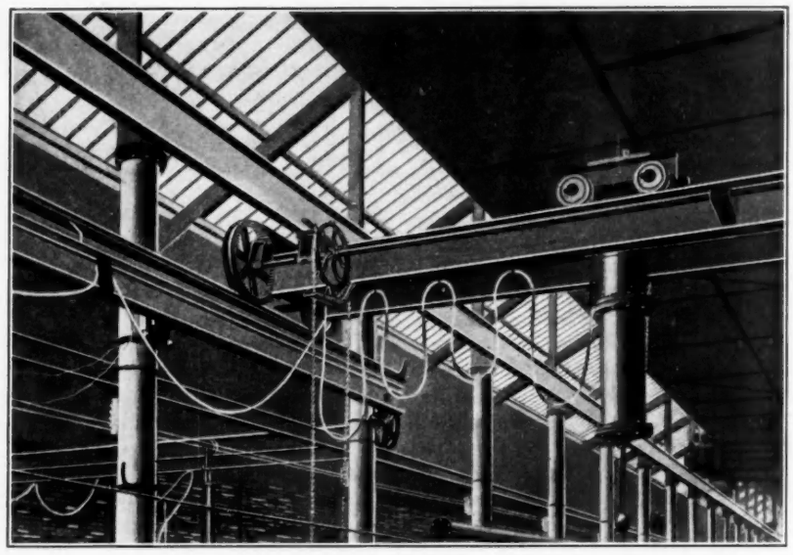


FIG. 3. BOTH METHODS OF SUPPORTING HOSE IN USE.

The left-hand side of the bent piece of iron is carried down as shown, to prevent the whole from falling in case the wheels run off the track. The clamp *c* embraces a short piece of curved iron pipe to which the hose is attached, as shown at *d* in Fig. 2, which, however, otherwise illustrates our most recent plan. The hose is here supported on a suspension wire *e*, and around it and the piece of bent pipe is a ring *f* composed of several turns of wire which are soldered together.

Both plans are shown in Fig. 3—the old one on the track supporting the hoist, and the new one on the bridge. The second plan gives us better satisfaction.

ARTHUR BOLLINCKX.

Brussels, Belgium.

Some Points in Drawing Room Practice.

Editor American Machinist:

Let me submit to your readers for their consideration, while we are interested in drawing room practices, which you are publishing just now, some schemes for keeping tracings which I ran across during the past year or two.

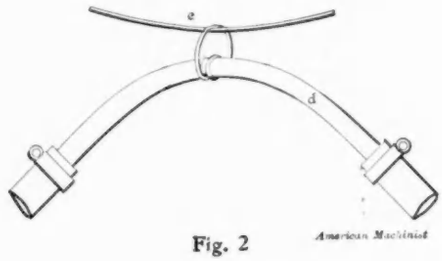


Fig. 2

One of them gets entirely away from the clumsy drawer which takes up considerable room, and the other makes the drawers, if we must have them, more easy to handle. The first scheme is, to my mind, the best system of putting tracings away, and is one used by a large concern in central New York, where I saw it about eighteen months ago.

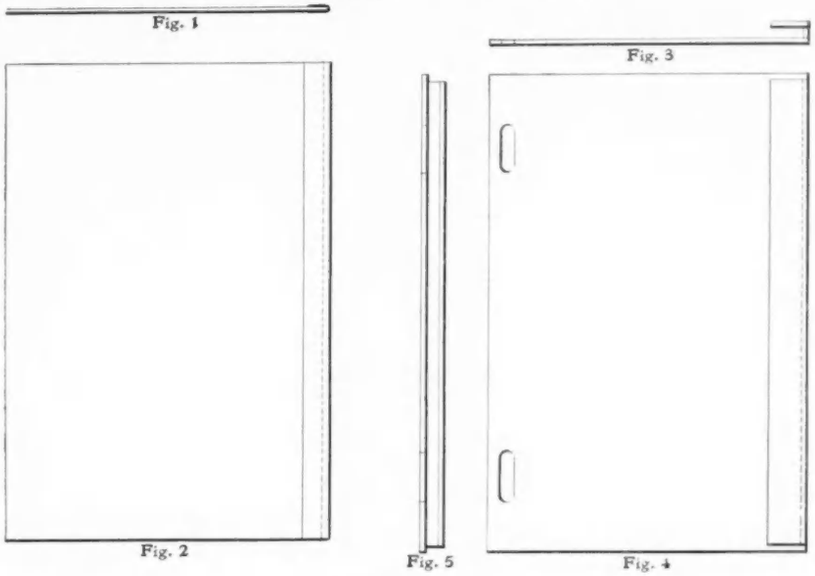
The tracings were kept in portfolios, made of heavy mill boards, about 3-16 inch thick, and joined together by a hinge of heavy linen along the back, as per Figs. 1 and 2. The portfolios were kept on shelves made of pine, about ½ inch thick, and were about 1½ inches apart. All the drawings were made one size, 24x36 inches. When a tracing was desired, it was a very easy matter to pull the portfolio out about 12 or 15 inches and turn up the right-hand corner, as the mill-board covers are flexible enough for that, and then turn up the corner of each tracing so as to read the title or its number. When you come to the desired one, pull it out, as the tracings slide out very easily, and they can be returned with as little trouble.

If desired for any reason, the whole portfolio can be taken out and laid on a table and gone over. This company had many thousands of tracings, and gave to each a consecutive number as it was made. The portfolios were given a letter and marked thereon. Each letter was in a number of volumes or portfolios, as AI, AII, AIII, AIV, etc.; this allowed for indefinite expansion, as a certain department could be under one letter, and its details subdivided among the volumes under this letter, and another department under some other letter. This number and letter also appeared upon the tracing along with its number, as 1001 BVII.

The shelves also had the letter and number of the volume marked on their edge, and very plainly showed at a glance what

each shelf contained. With a card index it seems to me as if this is about all that could be desired in the way of a neat, light, handy and convenient filing system for drawings or tracings, and from my experience with it, I do not think if anyone tried it that he would ever be inclined to go back to the drawers.

The other system has come to my notice of late in the way of drawers for tracings, and is called a skeleton drawer or sliding shelf (see Figs. 3, 4 and 5). It is supposed to be a little deeper than fifty tracings, as this number was the limit for each letter at the place this system is being used, as 1 A1 to 1 A50, then 2 A1 to 2 A50, and so on. The letter in this case represents the size of the sheet, and the figure preceding it the number of the drawer, while the number after the letter is the number of the tracing in that series or drawer.



FILING TRACINGS.

These drawers are made with only a bottom, and a back to keep the tracings from sliding out of the back end. These shelves are made very light, are easily handled and far superior to a regular drawer, which must be fairly heavy, and usually extra heavy when for drawings of a large size.

These sliding shelves are set far enough back in their stand to admit of doors that shut the dust out from them. When a tracing is wanted, the doors are opened wide to permit the particular shelf desired to be pulled out far enough to go over the tracings and to look at any one of them with ease.

There is one advantage in this system over the first one mentioned, and that is, the shelf gives a stiff backing to the tracing when you are looking at it in the drawer or shelf. I do not think any more need be said, as the sketches will tell the story better than writing. G. J.

A Case for Prepared Blueprint Paper.

Editor American Machinist:

The enclosed sketches illustrate a case for prepared blueprint paper. Referring to the illustrations:

A = heavy paper in use.
B = thin paper in use.
C = storage.
D = scraps.
E = end of paper ready to pull out.
F = guide slot for knife.
G = rubber weather strip.

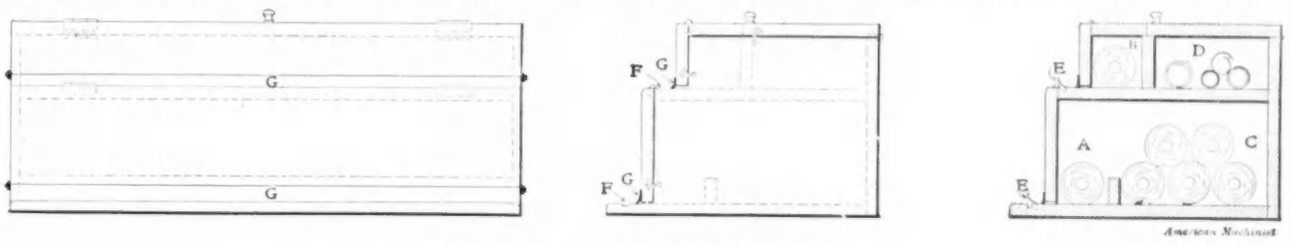
The box is very simple and compact. The large, lower door is hinged at the top and can be lifted high enough to allow the rolls to be placed in the space C.

The amount of paper needed is pulled out and cut off by running the knife in the slot F. This slot is far enough out to leave sufficient paper to easily catch hold of with the fingers, but not far enough to cause waste. The rubber strips prevent light from getting under the doors, where there is 1-16 inch clearance. The interior is painted black.

This style of case is not limited to two kinds of paper. It can be built as if another of same outline were put back of it and used from both sides, or it could be built up in steps one above another for any number of rolls, putting the storage at the bottom and scraps at the top.

We are using this in the drafting room at the Grant Tool Works, and find it to work so well and to be so very convenient that I thought it might be of interest to others. ERNEST J. LEES.

Franklin, Pa.



CASE FOR PREPARED BLUEPRINT PAPER.

A Modification of the Hendey Shaper Clutch.

Editor American Machinist:

I have seen several Hendey shapers in different shops, but until recently I have never worked on one, unless, possibly, to do a few minutes' job. Recently, however, I have had to operate an old one, which was, and is, somewhat the worse for wear.

More recent machines of this make contain, I believe, improvements which overcome the difficulties described below, but some of the older machines may still be in the hands of your readers, and to them my experience may be useful.

The ingenious clutch mechanism of this machine was very noisy, and it so happened that within a few hours I found myself doing a job on the machine. The clutch was dry, and emery had been applied "to make the clutches stick." With the parts cleaned and oiled the machine was as noiseless as you please, but it would not pull a cut. I refaced the hubs of the pulleys to reduce the movement of the double cone to about 1-32 inch, and found that with a light high-speed oil it would work nicely under a light cut, but it was still unsatisfactory for heavy work. If a very small quantity of light oil were applied to the cones, it would run fairly quiet and pull well, if all other adjustments were close and correct; but that very small quantity of light oil would soon become dry, and then the clutch would pound. Hence, I could not evade the conviction that, to be successful, it should have plenty of oil on the cones. The speeds are such as to call for a light oil, but it is a question whether or not it can be used plentifully. With conditions similar to those in question, there is a very decided limit to the amount of pressure per square inch under which a film

of oil may be retained between two surfaces. That pressure limit, and especially the time that it need be applied to bring the surfaces in contact, will be less as the viscosity of the oil is less; and as we have considerable leverage for the ram to shift the double cone with, and as the angle of the cones is slight, a very considerable pressure is obtainable—enough, I thought, to displace a film of light oil. However, the pressure will need to be applied for a little time, in order to displace it, as it must have time to get out from between the surfaces, if we wish to make metallic contact.

After the above reasoning I applied pressure with my hand, by means of the handle provided for that purpose; and I found that with the light oil on the cones, and plenty of it, I could easily drive a very heavy cut. After careful observation I concluded that, as under ordinary circumstances while the machine is at work the pressure is applied to the double cone to drive it into the pulley cones probably rather less than one-quarter second, the time was not sufficient for the oil to be squeezed out.

Now, suppose we have two pairs of surface plates with oil between, which we wish to squeeze out. One pair of plates is, say, 12 inches square and has plain surfaces. The other has grooves cut in both directions 1-16 inch deep and 1 inch apart—the plates being 12 11-16 inches on a side to make the total surface equal to the first plate. The second pair will have a total of 576 inches of edges from which the oil can escape and much less distance for the oil to travel, and the oil will obviously escape much more quickly. Reasoning in this way, I now secured the permission of my foreman and cut grooves in the double male cone. I took a sharp-edge triangular file and filed, I think, about 148 grooves crosswise in it, each about 1-32 inch wide and about ¼ inch apart. Then I put the cone on an arbor and turned grooves in it, about ¼ inch apart, and then put the shaper together again.

It has now been running about three weeks since these changes were made, and though we put plenty of a light high-speed oil on the cones it has given no trouble whatever, and does the heaviest work which is doable on a shaper of its size in the most satisfactory manner, besides running very quietly.

A heavy oil, especially lard oil, on the cones makes them slip; but perhaps this might be overcome, even with heavy oil, by making the grooves closer and the lands smaller. In this case it would probably "pound" with the light oil, though the line need not be drawn very fine; and I believe the cones will wear quite as well, by being grooved and using plenty of oil, as under the other conditions.

If these shapers can be made to work as nicely as this one does I believe they would be the most satisfactory tool of the kind on the market. They are well made and have a very rapid action on all lengths of stroke from ⅜ inch, or perhaps a little less, up to the capacity of the machine. Especially is time saved on short strokes, for the ram does not dwell at the end of the stroke as with the crank shaper. This is a peculiarity of this machine, and no other mechanism of the kind which has come under my notice can compete with it in this respect. F. H. BUCKINGHAM.

[We should expect that in time the circumferential grooves in one cone would produce ridges in its mate and thus lead to trouble. This tendency could be avoided by cutting a continuous spiral groove instead of the several circular ones described.—Ed.]

A Proposition, a Problem and a Paradox.

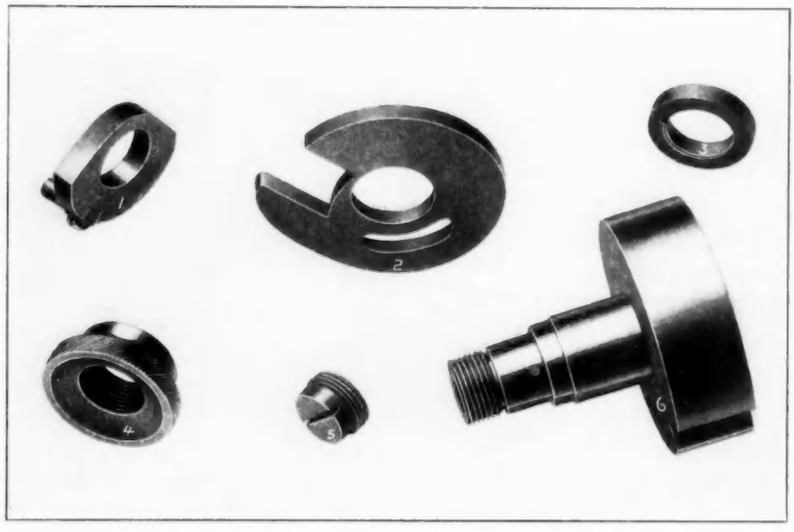
Editor American Machinist:

The proposition was: the cam, Fig. 1, to be adjustable on the spindle, Fig. 6, and locked with sufficient rigidity to withstand considerable shock. The spindle was required to reverse at high speed with a heavy spring pressure acting against the cam. The notch stop disk, Fig. 2, was free to rotate on the spindle within the limit of the concentric slot, controlled by the pin on the cam, Fig. 1.

The problem: to hold the cam and give it a reasonably fine and quick adjustment. As originally planned, the cam, Fig. 1, and the stop disk, Fig. 2, were held by forcing on to a taper on the spindle. Later it was found that the taper did not hold sufficiently.

The parts having been made, we were limited to the space shown.

The arrangement shown is the only practical method that was suggested. The taper which extended from the root of the screw to the first shoulder, Fig. 6, was turned off, leaving the shoulder as shown. The lock collars, Fig. 3, were made with radial teeth and keyed to the spindle against the shoulder. New cams were made with radial teeth registering with the teeth in the collar. The cams were held in engagement with the lock collars by the knurled nut and jam screw, Figs. 4 and 5. As the quantity to be made was limited, likewise the cost, elaborate or expensive tools were not to be thought of.



FIGS. 1 TO 6. THE PARTS TO BE MADE.

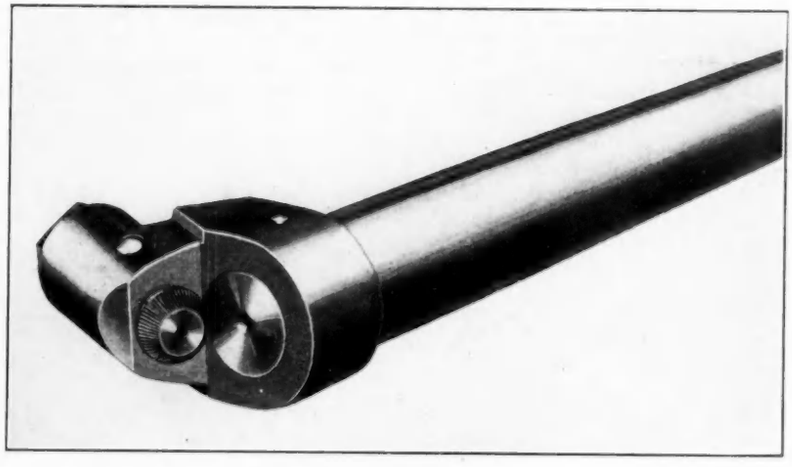


FIG. 7. RADIAL KNURL.

Now comes the part of the problem which led to the paradox. We did not consider it practical, with the facilities at hand, to stamp the teeth, and so decided to make a radial knurl and made the tool shown in Fig. 7. The pitch diameter of the tool was made half that of the collars. This we did for no special reason, as theoretically almost any other proportion would have answered as well. We figured that with 60 teeth in the knurl we would get 114 teeth in the collars. Instead, we got the paradoxical spacing of 118 teeth. This spacing does not agree with either the addendum or the pitch circle. The addendum spacing should make 114 teeth. This is the thing you would naturally expect the tool to do under the circumstances. The stock was run at high speed and the tool fed very slowly.

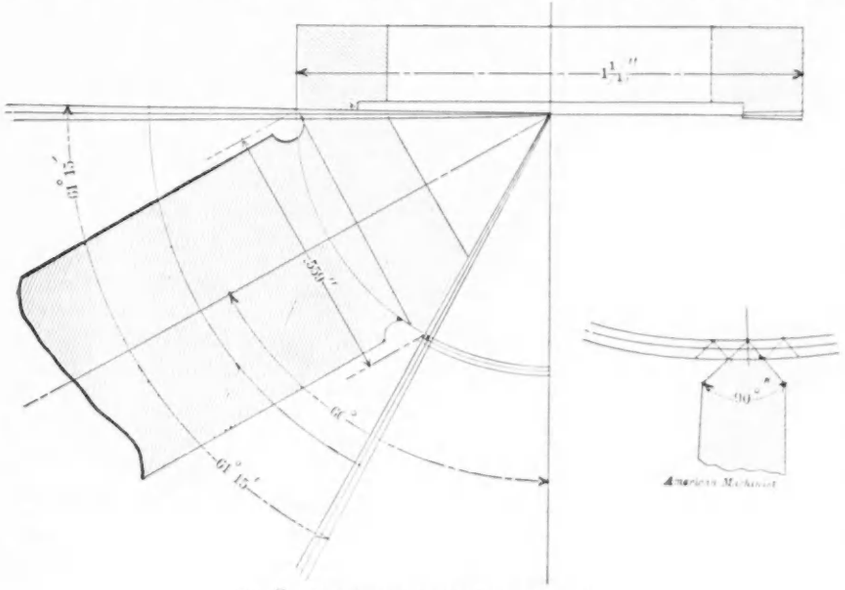


FIG. 8. METHOD OF LAYING OUT KNURL.

As our theory does not fit the fact, we are in search of one that will. The sketch, Fig. 8 explains the method of laying out the tool and developing the teeth. The tool was made with a ball thrust adjustable for wear.

W. A. WARMAN and R. B. COCHRANE.

The Goss Printing Press Company relate their experience with some raw hide pinions made by the New Process Raw Hide Company, of Syracuse, N. Y., and used in one of their presses with which the Paris edition of the New York "Times" was printed in the Exposition grounds last summer, and which experience is somewhat remarkable. Owing to the change of motors in the power station, there was a sudden increase of force, which broke the teeth out of some cast-iron gear wheels, and these broken teeth were driven into and imbedded into the raw hide pinions. The broken teeth were dug out of these pinions, new cast-iron gears put in, and the same raw hide pinions then ran to the end of the Exposition, and gave good service.

Plans for the Carnegie Technical Institute.

The committee on plan and scope appointed by Mr. Carnegie and consisting of William McConway, J. A. Brashear, W. L. Scaife, W. A. Magee and A. M. Brown have recently received the report of an advisory committee of educators appointed to assist in the preparation of preliminary plans. This report we give below:

REPORT OF ADVISORY COMMITTEE.

"It has become clear, both to educators and to business men, that the new century demands a wide dissemination of a new type of school training. The new methods of concentrated capital and of wholesale production; the ready means of transport by which antipodes have become both our customers and our sources of supply; the practical abandonment of both the apprenticeship system and of the individual manufacturer; the world-wide field of operations in all lines of trade; the infinite number of applications of scientific knowledge in all fields of modern industry; the whole-world competition which confines success to the most economic production; and the constant supplanting of manual labor and man-power by automatic machinery and by steam or electric power; these are some of the signs of the times by which it is clear that some new kind of preparation for the work of life must be introduced into the school training of both girls and boys. This, too, not only for their individual success, but for the maintenance of American leadership in manufacturing and commerce. What this new education should be for America may be exemplified by the proposed Carnegie technical schools of Pittsburgh. Nothing short of such a complete system should be planned.

"The scheme which your committee proposes may be divided as follows: First, the Carnegie Technical College; second, the Carnegie High School; third, the Carnegie artisan day and evening classes.

THE CARNEGIE TECHNICAL COLLEGE.

"This should be a first grade technical college, superposed upon a High school curriculum, with entrance requirements equal to those demanded by the best grade of existing colleges of engineering. It should be a school of both pure and applied science, and should prepare young men for leadership in the commercial as well as in the industrial pursuits. Both our manufacturing industries and our foreign commerce are now demanding the highest technical training it is possible to bestow, but this training must be fitted to particular vocations.

"This college should be made attractive to the greatest scholars in the fields of physical and chemical science. To obtain and hold such men they must be given ample opportunities for research. This college must be supplied, therefore, not only with great experimental shops and laboratories for students' use, but in all departments there should be splendidly equipped laboratories of investigation and research, under the direction of the head of such department, and with a full corps of assistants for the carrying on of lines of investigation which are now partly or wholly unprovided for in America. These well-equipped workshops, and these experimental and research laboratories would form the chief distinction of this technical college, and they would also be the chief item of expense. This college would support one or more publications in which the fruits of this research department would be given freely to the world. While the number of students in this college would be small, as compared with the number in the technical High school, the work done here would be of far more benefit to the world, and it would form the chief, if not the only, feature of the whole scheme to attract attention and to extend its beneficent influences beyond the immediate vicinity of Pittsburgh.

"Instruction in the technical college should include:

1—Technical courses in:
- a. Mechanical engineering.
- b. Electrical engineering.
- c. Civil engineering.
- d. Chemical engineering.
- e. Electro-Chemical Engineering.
- f. Marine engineering.
- g. Railway engineering.
- h. Sanitary engineering.
- i. Mining engineering and metallurgy.
- j. Architecture.
- k. Commerce and transportation.

2—Course in pure and applied sciences:
- a. Mathematics.
- b. Physics.
- c. Chemistry.
- d. Biology.
- e. Geology.
- f. Mineralogy.

g. Astronomy.
h. Economics.
i. Commercial geography.

3—Course in modern languages:
a. English.
b. German.
c. French.
d. Spanish.

THE CARNEGIE TECHNICAL HIGH SCHOOL.

"The work of this school should be superposed upon the work of the public grammar schools of Pittsburgh and Allegheny. Its scope should be broad and comprehensive. The elective principle should be recognized and graduation should depend not upon completing a prescribed curriculum, but upon completing a required number of courses, to be selected by the student under the direction of the directors of the school.

"In this school the boy who wished to fit himself for industrial pursuits would find equal advantages with the boy who desired to prepare himself for professional engineering or the girl who wished a general high-school education supplemented by instruction in the home-making arts.

"To make this instruction practical and fruitful of results, it would be necessary to have well-equipped shops and experimental laboratories in all the courses leading toward specific employments, and these require a liberal housing, an expensive equipment, and an expert direction by accomplished artisans. Such a complete school as is here proposed does not now exist in this country, but it would prove a pattern to be copied in every large city, and such as the new century and the new industrial conditions demand.

"Instructions should include:

1—The ordinary English studies.

2—Physics, chemistry and biology, with students' laboratory practice.

3—The elements of the Calculus and applied mechanics.

4—French, German and Spanish.

5—Commercial studies.

6—Domestic arts and sciences.

7—Freehand and mechanical drawing.

8—Technical studies, fitting for the industries of the locality, such as:

a. Blast furnace and foundry practice.
b. Glass making.
c. Brass founding and finishing.
d. Pattern making and joinery.
e. Metal working.
f. Stationary, locomotive and marine engine and boiler management.
g. Light and power station management.
h. Gas manufacture.
i. Railroad transportation.
j. Plumbing and domestic sanitation.
k. Surveying.
l. Clay working and ceramics.
m. Industrial art.

CARNEGIE DAY AND EVENING CLASSES.

"These classes are proposed for the benefit of those who are unable to take advantage of the more complete courses in the technical high school. They should be available to both sexes.

"Instruction should include:

a. Elementary mathematics.
b. Elementary physics.
c. Elementary mechanics.
d. Elementary chemistry.
e. Freehand and mechanical drawing.
f. Modern languages and elementary instruction in such technical subjects as taught in the technical high school.
g. Courses of special lectures on subjects of interest to artisan classes.

"In conclusion your committee desires to state that in its judgment a large tract of land, not less than 50 or 60 acres in extent, should be provided, in order that the buildings may be grouped about an attractive campus.

"Furthermore, the best educational experience leads us to believe that the highest interests of these schools will be conserved by being maintained as independent institutions unhampered by public or private control. Respectfully submitted,

"Signed "ROBERT H. THURSTON.
"VICTOR C. ALDERSON.
"THOMAS GRAY.
"J. B. JOHNSON."

Of the above scheme the Technical High School is to be unreservedly commended. As we understand it, it will consist of a series of monotechnic schools of which this country now has but very few and of which it needs many.

The scheme for a technical college is, however, a disappointment to us. We do not see wherein it will differ from a dozen existing schools except in being "a little more so." We had hoped that this great institution might face the problem of providing engineering education for boys from the shops who, to say the least, are just as well able to receive it as those from the high schools and who are now practically unprovided for in the educational scheme of the country. To do this would be to break new ground and provide a school having a distinctive character of its own. Considering Mr. Carnegie's history and antecedents we very much doubt if the plan outlined by the advisory committee so far, that is, as it relates to the technical college, is at all in accord with his intentions and desires in providing the foundation, though we well realize that in the nature of things he can do little more than provide the funds and leave the formation and execution of plans to others.

We do not, however, understand that these plans have been adopted. The committee on plan and scope are, as we understand it, seeking advice from various sources, one of which is naturally the professional educators of the country.

We know that among those who live in an atmosphere of work rather than in an atmosphere of books there is a decided feeling that something different from existing engineering schools is needed, and we hope that this feeling will in some way make itself felt among the committee on plan and scope. Such an opportunity as this for accomplishing a great educational work does not often present itself, and it will be a monumental pity if it results in nothing more than the practical duplication of existing schools.

A Million Dollar Watches.

A fact of some importance as bearing upon the perfection to which our punch and die work has been advanced in America comes to us in the form of an announcement by R. H. Ingersoll & Bro., of New York, that they have closed a sale with a London house for 1,000,000 Ingersoll watches, which is said to be the largest number of watches ever contracted for in one lot. These watches, as perhaps many of our readers know, are made entirely by the sub-press and similar tools, and are retailed at $1. They are simply a reduced copy of the small nickel clocks which are familiar in most American

(*Continued on next page.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 22.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Wanted—10-ton locomotive crane, standard gage, second hand. Atlas Engine Works, Indianapolis.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

See 12 presses & dies for sheet-metals, S. E. cor. Machinery Hall, Buffalo Exposition. Ferracute Mch. Co., Bridgeton, N. J.

Wanted—The address of a good and reliable machine shop for die making and steel press work. Box 288, AMERICAN MACHINIST.

Wanted—To make your brass and aluminum castings, light or heavy; write for prices. Casson & Middleton, 196-198 Liberty st., Paterson, N. J.

Wanted—Second-hand 60 in. x 60 in. x 12 or 14 ft. planer, also pit lathe to turn about 12 feet. Address The Conover Mfg. Co., 26 Cortlandt st., New York City.

A 200,000 lb. screw-power testing machine for sale cheap; this machine is in first-class order and will be sold for any reasonable offer. H. E. M., care AMERICAN MACHINIST.

Machinery built by contract; modern equipment and organization; accurate work; prompt delivery; low prices; weights up to 5 tons. The Blanchard Machine Co., Boston.

Gear and Milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears. Catalog of small tools free. R. M. Clough, Tolland, Conn.

Two hand-colored tempering charts (A and B), 36 steel-working receipts and free sample of Monarch Welding Compound, all for $1; these cover all difficult steel working; invaluable to machinists. W. M. Toy, Sidney, Ohio (40 years a steel worker).

For Sale—A one-third or one-half interest in an old and well-established machinery business in a large Eastern city; are doing a large business with increasing orders; correspondence invited from parties interested. Address Box 287, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Set of Bound Volumes for Sale.—We have for sale a set of bound volumes of the "American Machinist" from Vol. 3 to 18, inclusive; all in good condition; ten are bound in morrocco and six in cloth; leather-bound volumes have name of a former editorial writer on side; cloth-bound volumes unmarked; the entire set for sale at $4 per volume; a chance not often found; first order takes the books. AMERICAN MACHINIST PRESS, 218 William st., New York. (P. S.—One volume of Vol. 8 for sale at $2.)

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Foreman patternmaker is open for engagement. S. T., care AMERICAN MACHINIST.

Draftsman, graduate, with several years' experience, wants position. Box 302, AM. M.

Mechanical draftsman with 12 years' experience on engines, Corliss and others, would like to make change. Box 296, AM. MACH.

Draftsman, 4 years' experience, wants position in or near Boston; automobile or mechanical preferred. Box 293, AMER. MACH.

Experienced draftsman; last 5 years machine tools and fixtures; first-class American and German references. Address Hois. Wienerstr. 1, Berlin.

A designer and draftsman of successful automatic and special machinery desires employment. Address "Compasses and Square," care AMERICAN MACHINIST.

Wanted—Position as superintendent or foreman of machine shop, by a thorough mechanic of wide experience; can handle men in first-class manner. Box 294, AMER. MACH.

Mechanical engineer, of practical experience from the power plant to production, as foreman and master mechanic, solicits correspondence. Box 239, AMERICAN MACHINIST.

Position as superintendent or foreman of machine shop building high-class interchangeable work; young, energetic, ingenious, good disciplinarian; best references. Box 295, AMERICAN MACHINIST.

Position as superintendent or general foreman; am conversant with the machine business in all its branches, a designer of tools, jigs and modern appliances for economical production. Box 299, AMERICAN MACHINIST.

Engineer's License.—Machinists, engineers, firemen, electricians, etc.; 40-page pamphlet containing questions asked by Examining Board of Engineers sent free. Geo. A. Zeller, Publisher, Room 336, 18 S. 4th St., St. Louis, Mo.

Position of responsibility by an all-round machinist and toolmaker, experienced on engine, electrical, machine tools, instruments and automatic machinery; good systematic and executive ability in handling men and getting out work. Box 292, AMER. MACH.

Position as superintendent or general foreman, by an up-to-date American, 15 years' practical experience on steam and gas engines, pumps, air compressors, hoisting machinery, etc.; age 35; married; best references. Address Box 297, AMER. MACHINIST.

Superintendent of a large, progressive machine works, wants a change; 15 years' practical experience; technical education; good management should pay its own salary; will accept position on these conditions; can earn salary, or don't want it. Address Box 261, AMERICAN MACHINIST.

Position wanted by technical graduate; 10 years' experience as draftsman, designer, engineer and superintendent, both shop and construction; gas and steam engines, automobiles, air compressors, railroads, general machinery and elevators; moderate salary and chance to prove ability. Box 298, AM. MACH.

Help Wanted.

Wanted—Two first-class operators on Gisholt turret lathe. Box 185, AMER. MACH.

Patternmaker wanted for textile machinery; steady job; good pay. Box 289, AM. M.

Wanted—Experienced men for responsible positions. Address James Brady, 220 Broadway, New York.

Wanted—First-class lathe hands, planer hands, boring mill hands and fitters. American Turret Lathe Co., Wilmington, Del.

Wanted—Competent draftsman in sugar machinery for New York. Address, with full particulars, Box 300, AMER. MACHINIST.

We solicit applications from reliable machinists; state references and experience. Address Box 256, AMERICAN MACHINIST.

Wanted—First-class toolmaker; state experience, references and wages wanted. Apply to Northern Engineering Works, Detroit, Mich.

Wanted—A first-class patternmaker to take charge of pattern shop and capable of getting out work promptly. Apply Box 564, Wilmington, Del.

Capable boilermaker wanted to take charge of small plant manufacturing transformer tanks. Apply at Stanley Electric Mfg. Co., Pittsfield, Mass.

Wanted—As editor in charge of a technical trade journal, a newspaper man of experience and an engineering education. Address "Editor," P. O. Box 876, New York.

Good patternmakers, both wood and metal, desiring steady employment, will find it to their advantage to apply to the General Electric Co., Schenectady, N. Y.

Wanted—Operators for turret lathes, engine lathes and screw machines; only experienced men need apply; give references. Vt. Farm Machine Co., Bellows Falls, Vt.

Wanted—Competent draftsman, experienced in large Corliss engine work preferred; state age, experience, previous and present employers. Address Box 278, AMER. MACH.

We invite applications from machinists and molders; give references, experience and wages expected; work on air compressors. Franklin Air Compressor Co., Franklin, Pa.

Wanted—Foreman or assistant superintendent for shop employing 25 hands on strictly manufacturing work; in applying state age and experience. Box 290, AMER. MACHINIST.

Wanted—Competent draftsman with experience in designing Corliss engines, air compressors and mining machinery; state age, experience and salary expected. Box 270, AMERICAN MACHINIST.

Salesman wanted, one of experience and ability, to sell general line of metal working machinery; good salary to right man; write full particulars. Address "New York," care AMERICAN MACHINIST.

Wanted—Young man of inventive ability who has made a study of pneumatic tools, either practical or theoretical; permanent position for the right party. Address Box 279, AMERICAN MACHINIST.

Wanted—A few competent draftsmen who have had experience on instrument work, for positions with large New York factory; state experience and salary expected. Address E., care AMERICAN MACHINIST.

Wanted—By electric manufacturing company, a first-class mechanical draftsman experienced on motors and generators; state experience, references and salary expected. Address "Electric Mfg. Co.," care AM. MACH.

Wanted—Practical, up-to-date machine shop foreman; must be a hustler, steady and reliable, capable of handling men advantageously, experienced in heavy engine work; state age and experience. Box 301, AMER. MACH.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

First-class experienced mechanical draftsmen wanted at once, some of them acquainted with electrical work; those with shop experience preferred. Apply, by letter, to "Chief Draftsman," P. O. Box 911, Pittsburgh, Pa., stating experience in full and giving references.

Wanted—Foreman for machine room on interchangeable work; must be young and familiar with up-to-date shop system and capable of forcing production; state age, past history and salary expected; correspondence will be treated as confidential. Address Box 291, AMERICAN MACHINIST.

A practical and thoroughly competent machinist as shop foreman and instructor; one familiar with the manufacture of machine tools preferred; some knowledge of pattern-making, foundry work and blacksmithing preferred, but not essential. Address immediately Box 453, Pullman, Wash.

Wanted—Foreman, repair department, by textile manufacturers having a first-class plant; must be a thorough mechanic, good engineer, able to make electrical repairs, etc.; wages $4 per day and no time lost. Address,

(*Continued on next page.*)

(*Continued from preceding page.*)

homes. Of course they lack the fine finish and adjustment of high-grade watches, but they answer the purpose for very many whose dollars are not plentiful; and bearing on this phase of the question it may be interesting to note that a short while ago, in a store window not far from the "American Machinist" office, some of these watches were exposed for sale with a notice to the effect that they would be sold upon installments, with the privilege of paying 5 cents a week until paid for. This shows that there is probably a demand for watches among those to whom even a dollar is a large sum, and who must therefore make it up by the savings of twenty weeks.

Machinery in Glass Blowing.

President Hays, of the Glass Bottle Blowers' Association, in an address delivered in Milwaukee, recently said:

"If the courage displayed in opposing machinery had been devoted toward reducing the hours of labor, eliminating child labor from the factory entirely, making it possible for the workers to secure some of the benefits brought into existence by the introduction of the machines, we would to-day have something to show for these mighty efforts."

In issue No. 27 we stated that the Stanley Electric Manufacturing Company, of Pittsfield, Mass., had voluntarily granted a nine-hour day with ten hours' pay, besides 5 per cent. increase of wages, to its employees. This was based upon a statement by a local paper (we think published in Pittsfield) and we supposed it was correct. Its accuracy is denied, however, by residents of Pittsfield, who say that the works run fifty-five hours per week, and that the hourly rate has been advanced 5 per cent.—not enough to make up for the reduced time plus 5 per cent., as would be inferred from the item referred to.

In reply to many inquiries we state that copies of the professional papers presented at the recent Milwaukee meeting of the American Society of Mechanical Engineers can be obtained by addressing the secretary of the society, at 12 West Thirty-first street, this city. Mention of this fact was inadvertently omitted from our report.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., announce that they intend closing their works Saturdays at 12 o'clock noon during the continuance of the warm weather, and request that, so far as possible, their friends arrange to have orders reach them in time for early Saturday shipment.

Inquiry for Machinery.

(154) Wanted, names and addresses of manufacturers of electrical machines for hardening steel.

Personal.

Mr. Harry M. Perry, who has been manager of the Southern branch of the Ingersoll-Sergeant Drill Company at Houston, Tex., has returned to New York, the office at Houston having been discontinued.

Mr. Frank B. Ward, who for over two years has had charge of the Cleveland office of Manning, Maxwell & Moore, resigned that position July 1 to take charge as manager of the branch offices of the Niles-Bement-Pond Company in Cleveland and Pittsburgh.

Frank H. Cathcart, formerly master mechanic of the Pencoyd Iron Works, has resigned his position with the American Machine & Foundry Company, of Hanover, Pa., to accept the position of general superintendent of the Algoma Iron Works, Sault Ste. Marie, Ont., Canada.

Geo. H. Wadsworth, for the last six years general superintendent of the Falls Rivet & Machinery Company, Cuyahoga Falls, Ohio, has resigned his position to devote his entire time to the management of the business of the Wadsworth & Sherwin Improved Core Machine Company, of Cuyahoga Falls.

Obituary.

John A. Slater, superintendent of the Norwalk Iron Works, died at South Norwalk, Conn., July 12, sixty-five years old.

Henry Watson, a retired master mechanic, died at Roxborough, Pa., July 4, eighty-five years old. Born in Lancashire, England, he went to Philadelphia in 1836. He was for many years in charge of the Megargee Paper Mills on the Wissahickon.

Frank J. Patterson, vice-president of the National Cash Register Company, Dayton, Ohio, died suddenly July 4, fifty-two years old. Mr. Patterson became interested in the National Cash Register in 1882, and, with his brother, purchased the plant, which was then capitalized at $10,000. The business, as all the world knows, has been eminently successful, the present capital being $5,000,000. The deceased was familiar with, and his influence extended to every detail of the business.

Harry F. Doane, superintendent of the works of the Morgan Engineering Company, Alliance, Ohio, died in that city July 1 forty-five years old. He was a native of Philadelphia, but his boyhood was mostly passed in Alliance, and after leaving the public schools he entered the above works to become a machinist. He was subsequently a fireman and then an engineer on several railroads, returning to his original shop in 1884 as foreman of the gear department and finally becoming superintendent of the plant. A stomach trouble compelled him to give up work eight months ago.

Help Wanted—Continued.

giving age, experience and full particulars, to C. & Co., P. O. Box 1816, New York City.

Wanted—Men to fill the following positions: Superintendent of rolling mill, superintendent of foundry, superintendent of works building mining machinery, foreman of galvanizing plant, steam engine draftsman; none but men at present engaged need apply. Address James Brady, 220 Broadway, New York City.

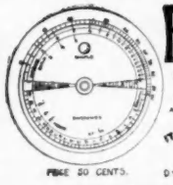
Blacksmith Wanted.—A fine opening for a young man of excellent character and habits with skill in forging or knowledge of foundry work, who wishes to become teacher in manual training, as assistant instructor in large school at salary of $60 per month the first year. Apply, stating age, education and experience in forging or foundry work, to "Blacksmith," care AMERICAN MACHINIST.

General superintendent, by a Canadian firm employing 150 hands, manufacturing mining and general machinery, with foundry, machine, boiler and smith shops; would require to act as chief draftsman and designer and able to organize for economical production; state age, experience, references and salary; it will save time to be definite on these points. I. Matheson & Co., Ltd., New Glasgow, Nova Scotia.

Foundry foreman; must be a thorough molder, know how to handle 30 men to advantage; castings made from 10 tons down to light implement castings, also building work; 42 in. cupola used, pouring one heat of 6 tons every workday; in answering, be explicit, stating age, experience, references, name of present employer, salary expected, etc.; must be sober and thoroughly reliable. Address "Hawkeye State," care AM. MACH.

Machinists, patternmakers, molders, boilermakers, blacksmiths, brass molders and finishers can secure steady employment at wages 25 to 35 per cent. higher than paid in East, in the cities of Seattle, Tacoma, Everett, Whatcom, Fairhaven, Olympia and Ballard, State of Washington; delightful climate; cost of living no higher than Eastern cities of same class. Apply to F. W. Mitchell, Secretary Pacific Coast Metal Trades' Association, Seattle, Wash.

Foreman for a long-established company manufacturing high-grade machine tools; opening is an exceptionally good one to a man capable of running the shops on strictly modern lines; must be a first-class mechanic in every particular and also possess executive qualities of a high order; to such a man, having pride in the product of his shop, a good salary will be paid; communications will be treated confidentially; full references required. Address Box 284, AMER. MACHINIST.



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By Parsell & Weed. Price, $2.50
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By Prof. T. O'Conor Sloane. Price, $2.50
Gas, Gasoline and Oil Engines,
By Gardner D. Hiscox. Price, $2.50
Complete Electrical Library (5 volumes),
By Prof. T. O'Conor Sloane. Price, $5.00
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By H. T. C. Kraus, C. E. Price, $2.50
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New, revised and enlarged edition. Price, $1.00
Saw Filing and Management of Saws,
By Robt. Grimshaw. Price, $1.00
Compressed Air and its Applications, (shortly).

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Draftsmen Wanted.

We have positions open for capable, experienced Mechanical Draftsmen. Our business is to assist Draftsmen and Engineers (technical men only) to secure positions when unemployed, and to better their positions when employed. Our business was established in 1893.

No registration fee. THE ENGINEERING AGENCY, 1605 Monadnock Block, CHICAGO.

Wanted.
NON-UNION MACHINISTS.

Tool-makers, good all around Machinists, Erecting hands and Filers. Good Pay, Permanent Positions.

AMERICAN ORDNANCE CO.,
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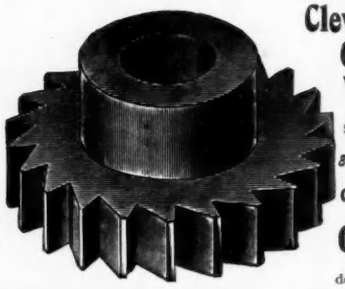

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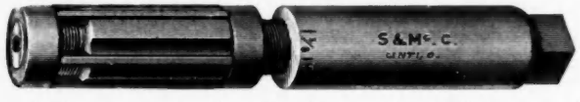

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Schellenbach, McCrosky & Huber, 208 LAWRENCE STREET, CINCINNATI, OHIO.